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ANNUAL REPORT

OF THE

GEOLOGICAL SURVEY

OF

PENNSYLVANIA

FOR

1886.

IN FOUR PARTS.

PART I. PITTSBURGH COAL REGION.
PART II. OIL AND GAS REGION.
PART III. ANTHRACITE COAL REGION.
PART IV. MISCELLANEOUS REPORTS.

By the STATE GEOLOGIST.

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PART II.

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1887.

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ANNUAL REPORT, GEOLOGICAL SURVEY OF PENNSYLVANIA,

1886.

PART II.

REPORT ON THE

OIL AND GAS REGIONS.

By John F. Carll.

Report on the Composition and Fuel-Value of
NATURAL GAS,
By Francis C. Phillips.

A LIST OF

PUBLICATIONS RELATING TO PETROLEUM.

WITH 1 PAGE PLATE MAP, AND 5 DOUBLE PAGE PLATES IN THE TEXT;
AND 2 STATISTICAL CHARTS, 1 MAP OF THE OIL AND GAS
REGIONS, AND 1 MAP OF SOUTH-WEST PENNSYLVANIA IN THE POCKET OF THE VOLUME.

TABLE OF CONTENTS.

Page.
Members of Commission, ... iii
Survey Assistants, ... iv
Table of Contents, ... vii
List of Illustrations, Annual Report, 1886, Part II, . . ix

Report on the Oil and Gas Region.

By JOHN F. CARLL.

CHAPTER I—History of the Development of Oil and Gas in Pennsylvania and New York, ... 575
CHAPTER II—Geography and Topography, ... 605
CHAPTER III—Summary of Geological Structure, . . 612
CHAPTER IV—Developments during 1886, ... 618
CHAPTER V—Stratigraphical Review of the Venango Oil group and overlying rocks, ... 636
CHAPTER VI—Notes Relating to Natural Gas wells and Pipe lines in the vicinity of Pittsburgh prior to January 1, 1885 664
CHAPTER VII—Well Records Oil and Gas
in McKean county, ... 695
" Warren county, ... 699
" Forest county, ... 700
" Elk county, ... 707
" Butler county, ... 711
CHAPTER VIII—Well Records in Westmoreland county, 721
" Allegheny county, . . 730
CHAPTER IX—Well Records in Washington county, . 754
" Greene county, . . . 772
" Allegany county, N.Y., 774
" Potter county, Pa., . 775
" Indiana county, . . . 776
" Jefferson county, . . . 777
" Fayette county, . . . 778
" Beaver county, . . . 779
" West Virginia, ... 781
" Ohio, ... 784

Report on the Composition and Fuel-Value of Natural Gas.

By FRANCIS C. PHILLIPS.

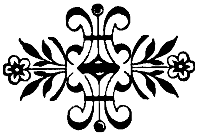
Page.
Introduction, ... 787
Collection of samples, ... 792
Method of analysis, ... 793
Selection of samples, ... 799
Analysis of Fredonia gas, ... 801
Analysis of Sheffield gas, ... 802
Analysis of Wilcox gas, ... 804
Analysis of Kane gas, ... 805
Analysis of Speechley gas, ... 806
Analysis of Murrysville gas, ... 807
Analysis of Raccoon Creek gas, ... 810
Analysis of Baden gas, ... 811
Analysis of Houston gas, ... 812
Calculation of the Fuel-Value of Natural gas, ... 816

A List of Publications Relating to Petroleum.

Abbreviations used, ... 828
Bibliography, ... 830

LIST OF ILLUSTRATIONS, ANNUAL REPORT, 1886, PART II.

Page.
Map showing the position of Columnar sections, . . . 638
Sections showing the geological structure from Allegany county, N. Y., to Mercer county, Penn'a, . 644
Sections showing the geological structure from Potter county to Clarion county, ... 646
Sections showing the geological structure from Warren county to Butler county, ... 648
Sections showing the geological structure from Forest county to Pittsburgh, ... 654
Sections showing the geological structure from Pittsburgh to Waynesburg, ... 658
Statistical Chart No. 1 of the Oil regions of Pennsylvania and New York, showing the annual production, the annual average price per barrel and total value of crude oil at the wells, ... in pocket.
Statistical Chart No. 2 showing the number of wells completed, the average daily production for each month, and the total production and shipment for each year, ... in pocket.
Map of the Oil regions of Pennsylvania and New York, ... in pocket.
Map of South-west Pennsylvania, in two sheets, in pocket.



THE OIL AND GAS REGION.

JOHN F. CARLL, *Assistant Geologist.*

CHAPTER I.

History of the Development of Oil and Gas in Pennsylvania and New York.

The history of petroleum developments in Pennsylvania and New York, from the earliest mention of the Cuba oil spring in 1627 to the drilling of Drake's well in 1859 is very fragmentary and unsatisfactory. Almost every publication on petroleum contains several extracts, (frequently from unknown sources) relating to its early discovery by the whites, and its uses; but it yet remains for a future historian to collect and verify the fragmentary notes and arrange them in systematic order. In this place we can only give a few of the historical items that have incidentally come to notice while studying the Pennsylvania Oil Fields. They will be arranged somewhat in chronological order, so that the reader may get a general idea of the successive steps by which the petroleum industry has advanced from the primitive skimming of an oil spring with a piece of bark and the restricted use of the material to medicinal purposes, to the drilling of wells 3,000 feet deep, the pumping of oil over mountain and valley to the sea-board and the flooding of the world with an inexpensive illuminant.

1627. Joseph Delaroche Daillon, a French missionary, having penetrated into the Lake Erie wilderness, now a part of the State of New York, describes the section visited, in a letter dated July 18, 1627, (published in Sagard's Histoire du Canada, 1632) and mentions among other things "a good kind of oil which the Indians call *Antonontons*." The oil seems to have come from the spring near the present town of Cuba in

Allegany county, New York, and this is probably the earliest reference to the petroleums of this region on record. (*a*)

1642. About this time, according to Charlevoix, several Jesuits penetrated into the same country, and approaching the territory of the ancient Eries, "found a thick, oily, stagnant water, which would burn like brandy." (*b*)

1670. The map made by the missionaries Dollier and Galinee, (reproduced in "Histoire de la Colonie Francaise," Vol. 3 page 305, Paris 1866,) has marked on it "*Fonteaine de bitume*" near where the town of Cuba is now located. This is probably the first mention of petroleum ever made on a map of this country. (*c*)

1700. The Earl of Bellmont, Governor of New York, instructs Chief Engineer Wolfgang W. Romer to visit the Five Nations and says,—"You are to go and view a well or spring which is eight miles beyond the Seneks furthest castle, which they have told me blazes up in a flame when a lighted coalé or firebrand is put into it; you will do well to taste the said water, and give me your opinion thereof and bring with you some of it.' (*d*)

1721. Charlevoix, in the journal of his voyage and travels, under date of May 1721 says: "The course of this river, [the *Casconchiagon*, or Genessee,] is 100 leagues; and when we have gone up it about sixty leagues we have but ten to go by land, taking to the right, to arrive at the *Ohio*, called *La Belle Reviere*. The place where we met with it is called *Ganos*, where an officer worthy of credit [M. de Joncaire as afterwards explained] assured me that he had seen a fountain, the water of which is like oil and has the taste of iron. He said, also, a little further there is another fountain exactly like it, and that the savages made use of it to

---

(*a*) These early facts are largely quoted and condensed from a carefully prepared and very interesting paper read before the Historical Society of Pennsylvania, March 13, 1876, by Mr. William J. Buck; to which the reader is referred for fuller details. (*b*) Ibid.

(*c*) Buck. (*d*) Ibid.

appease all manner of pains." *Ganos*, according to James Bruyas, a missionary on the Mohawk, in 1667, is derived from *genie*, or *gaienna*, which, in the Iroquois language signifies liquid grease or oil. (*a*)

1745. About this time John Frazer, the first white settler in the Oil regions is said to have built a cabin at *Wenango* (now Franklin) where he kept a gun shop and traded with the Indians until 1753 when he was driven away by the French.

1749. De Celoron's expedition from Lake Erie, over the portage to Chautauqua lake, thence down the outlet to the Allegheny river at Warren and thence down the Allegheny and Ohio to the mouth of the great Miami. The expedition was made for the purpose of formally taking possession of the country in the name of the king of France, and six leaden plates bearing an inscription to that effect were buried with great ceremony at suitable points along the river. It is a little singular that no mention of petroleum is made in the journal of this expedition, which was composed of about 300 men—French soldiers, Canadians and friendly Indians. (*b*)

1750? An extract widely quoted, and said to be from "a report of the commandant of Fort Du Quesne to Gen. Montcalm, in 1750," gives a graphic account of the scenes witnessed by the writer during the religious ceremonies of the Seneca Indians at an oil spring which had been fired for the occasion; and locates the spring on Oil Creek, a short distance from its confluence with the Allegheny—about where Rouseville now stands. Fort Du Quesne, as seen below, was built in 1754 and abandoned by the French in 1758. The account of these ceremonies, therefore, if attributed to the right source, could hardly have been written earlier than 1755.

1753. French forts built at Presque Isle (Erie), Le Boeuf

(*a*) Buck. (*b*) For full account of this expedition and fac simile of leaden plates, see "History of Venango Co" published by J. A. Caldwell, Columbus, Ohio, 1879.

(Waterford), and Fort Machault commenced at Wenango (Franklin). Washington, commissioned by Gov. Robt. Dinwiddie to deliver a letter to the French commandant on the Ohio, arrived at Wenango Dec. 4th, where he "found the French colors hoisted at a house from which they had driven Mr. John Frazer, an English subject." No mention of petroleum in Washington's journal.

1754. Fort Machault completed in April. The English driven from their Military Post at the junction of the Allegheny and Monongahela April 16th and Fort Du Quesne immediately built by the French.

1758. Fort Du Quesne abandoned by the French. "Washington, at the head of his command, took possession of the abandoned Fort on the 25th of November. Being mostly destroyed, a new fortification was thrown up on the bank of the Monongahela, named Fort Pitt."(a)

1759. Forts Machault, Le Boeuf and Presque Isle abandoned and burnt by the French, and Fort Niagara taken by the English in August.

1760. Fort Franklin built by the English at Venango, a few rods from the ruins of old Machault. English in possession of the country and free intercourse between Fort Du Quesne and Fort Niagara until 1763, but no mention of the petroleum springs.

1763. Indian massacre of the whites at Fort Franklin and Fort Le Boeuf, and country left almost in the sole possession of the Indians for several years.(b)

1767. The Moravian Missionary, David Leisberger, penetrated into the region of the Allegheny river in the autumn of 1767, and established a mission at *Goshgoshunk* [near the mouth of Tionesta creek], afterwards removing to *Lawanakanuck* [probably near Hickorytown], and thence in April, 1770, to *Kaskaskunk*, [in Butler county].(c)

The following is quoted from one of his manuscripts: "I have seen three kinds of oil springs—such as have an outlet, such as have none, and such as rise from the bottom of the creeks. From the first, water and oil flow out together, the oil impregnating the grass and soil; in the second, it gathers on the surface of the water to the depth of the thickness of a finger; from the third, it rises to the surface and flows with the current of the creek. The Indians prefer wells without an outlet. From such they first dip the oil that has accumulated; then stir the well, and, when the water has settled, fill their kettles with fresh oil, which they purify by boiling. It is used medicinally, as an ointment for toothache, headache, swellings, rheumatism and sprains. Sometimes it is taken internally. It is of a brown color, and can also be used in lamps. It burns well."(*a*)

(a) Hist. of Venango Co., p. 56. (b) Ibid, p. 66. (c) Ibid, p. 69, from "Loskiel's History of Moravian Missions."

Sir William Johnson, who visited Niagara in the summer of 1767, says in his journal: "Ascushan came in with a quantity of curious oyl, taken at the top of the water of some very small lake near the village he belongs to." Subsequent remarks in the journal make it clear that the *oyl* came from the Cuba spring.(*b*)

1783. Gen. Benjamin Lincoln, in a letter to Rev. Jos. Willard, President of the University of Cambridge, says: "In the northern parts of Pennsylvania there is a creek called Oil Creek, which empties itself into the Allegheny river, issuing from a spring, on the top of which floats an oil, similar to what is called Barbadoes' tar, and from which may be collected by one man several gallons in a day. The troops in marching that way, halted at the spring, collected the oil and bathed their joints with it. This gave them great relief, and freed them immediately from the rheumatic complaints with which many of them were affected. The troops drank freely of the waters—they operated as a gentle purge."(*c*)

(*a*) Buck, from Bishop De Schweinetz's Life of Leisberger, p. 353. (*b*) Buck.

(*c*) Buck, from 'Memoirs of the American Academy of Arts and Sciences," Vol. I., p. 375, Boston, 1785. Also sometimes attributed to the "Massachusetts Magazine" of July, 1791 and also 1789.

Dr. John David Schopf, a surgeon to the Hessian troops in the British service, visited Pittsburgh in 1783, and in an account of his travels, says "that he had been informed that petroleum was found at several places up the Allegheny, particularly at a spring and a creek which was covered with this floating substance."(*a*)

1785. In a letter from "Gen. William Irvine, to his Excellency John Dickinson, Esq.," dated Carlisle, August 17, 1785, and containing the "Notes taken and observations made by the Agents appointed to explore the tract of country presented by the State to the late troops of the Pennsylvania Line of the American Army"—the following note is found: "Oil Creek has taken its name from an oil or bituminous matter being found floating on its surface. Many cures are attributed to this oil by the natives, and lately by some of the whites, particularly rheumatic pains and old ulcers. It has hitherto been taken for granted that the water of the creek was impregnated with it, as it was found in so many places, but I have found this to be an error, as I examined it carefully and found it issuing out of two places only—these two are about four hundred yards distant from [each] other, and on opposite sides of the creek. It rises in the bed of the creek at very low water, in a dry season I am told it is found without any mixture of water, and is pure oil; it rises, when the creek is high, from the bottom in small globules; when these reach the surface they break and expand to a surprising extent, and the flake varies in color as it expands; at first it appears yellow and purple only, but as the rays of the sun reach it in more directions, the colors appear to multiply into a greater number than can at once be comprehended."(*b*)

1789. "George Henry Loskiel, in his 'Geschichte der Mission der Evangelischen Bruder unter den Indianern in Nordamerika,' published at Barby, Germany, in 1789, (pp. 151–2) thus writes:"

(*a*) Buck. (*b*) Hist. of Venango Co., p. 101, from Penna. Archives, Vol. XI.

"One of the most favorite medicines used by the Indians is *fossil oil*, (Petroleum) exuding from the earth, commonly with water. * * * It is observed both in running and standing water. In the latter the oil swims on the surface and is easily skimmed off, but in rivers it is carried away by the stream. Two [springs] have been discovered by the missionaries in the river Ohio. They are easily found by the strong smell they emit. * * * This oil is of a brown color, and smells something like tar. When the Indians collect it from a standing water, they first throw away that which floats on the top, as it smells stronger than that below it. Then they agitate the water violently with a stick; the quantity of oil increases with the motion of the water, and after it has settled again, the oil is skimmed off into kettles and completely separated from the water by boiling. They use it chiefly in external complaints. Some take it inwardly, and it has not been found to do harm. It will burn in a lamp. The Indians sometimes sell it to the white people at four guineas a quart."(*a*)

1795. In this year the first Gazetteer of the United States was published by Joseph Scott, of Philadelphia. Referring to Allegheny county, it says:

"In this county is Oil Creek; it flows from a spring much celebrated for bitumen, resembling Barbadoes' tar, and is known by the name of Seneca Oil. It is found in such plenty that a man may gather several gallons in a day. It is said to be a sovereign remedy for various complaints."

"Pittsburgh contains a post-office and about 200 dwellings."(*b*)

Town of Franklin laid out. Lands granted by the State to the Indian Chief "Cornplanter" staked out, and many other tracts surveyed.

1797. Jonathan Titus settled at Titusville on lands afterwards made famous in connection with the drilling of the first oil well by Col. Drake in 1859.

(*a*) **Buck.** (*b*) **Buck.**

1803. Soldiers withdrawn from the Fort at Franklin, and many permanent settlers coming into the country.

We have now followed the early accounts of petroleum down to the close of its Indian history. About the year 1800 the unrestricted settlement of the country by the whites commenced. Permanent homes are now being established, the most available lands near springs and streams are cleared for cultivation, and the hardy pioneers in this new and wonderful land diligently explore every mountain and ravine and valley for salt, oil, coal or other minerals that may serve to enhance the value of their possessions.

Now, for the first time is brought to our notice, the existence of curious pits, dug on the low grounds of certain streams and always in the neighborhood of oil seeps. The Indians are questioned concerning them but deny all knowledge of their origin. When, and by whom they were dug, was a mystery then, and remains a mystery still.

Large numbers of these pits were found on Hosmer Run, in Pittsfield and Spring Creek townships, Warren Co. (see I 4 p. 251) and as this is still an uncultivated region, some may be seen there to-day. They were found at Pithole, where oil was obtained so freely in 1865; near Titusville, where the Drake well was drilled in 1859, and in other places on Oil Creek; on French Creek, and no doubt in other localities of which we have no record.

It will be noticed that the extracts quoted above do not give a hint of their existence, and there seems to be no proof of record that the Indians or French ever referred to them. Still it is sometimes asserted that they were dug by the French. Prof. Peckham in the Census "Report on the Production, Technology and uses of Petroleum and its Products," (page 77) says: "In the United States several different methods for obtaining oil were employed before wells were drilled. It is reported that shafts were found in the Mecca (Ohio) oil district, of the sinking of which all record or tradition has been lost. Since the curbed pits on

Oil Creek, Pithole Creek, and other tributaries of the Allegheny have been proved to be of French origin, it is not unlikely that the old shaft at Mecca was also made by the French." How the Pennsylvania pits have been "proved to be of French origin" is not stated, and without some positive record of the fact we can hardly believe that it has been done.

It is evident that the pits were dug for the purpose of collecting petroleum; also, that they belonged to a people who had free range of the country, and who were familiar with every spring, and ravine, and watercourse in it; for in every place in the region where it was possible to obtain surface oil, their pits were found. Not one available spot had been overlooked. Could the French have prospected and developed the country so thoroughly during their short occupation? A great deal of oil must have been collected, or else so many pits would not have been dug. What became of it? The troops could not have used so much, and if there was a foreign demand, why is history so silent upon the subject? If exported it must have gone out by way of Fort Niagara, but we have no knowledge of shipments in that direction. When the English took the fort in 1759 they found no evidence that such a traffic had been carried on. They were so absolutely ignorant of the fact in 1767 when Sir William Johnson visited the fort, that the "curious oyl" which an Indian brought from the Cuba spring was regarded as a great novelty.

The arguments in favor of the great antiquity of these old oil pits are very clearly set forth in "Petrolia; A History of the Oil Regions of Venango Co." by Rev. S. J. M. Eaton, of Franklin, published in 1866, from which the following abstracts are taken:

"There are some strange facts in connection with this region, that point to a history all unwritten save in a few brief sentences, in pits and excavations, of oil operations along the valley of Oil creek, and near its mouth on the Allegheny. These detached fragments, like the remains of the Sybilline oracles, but cause us to regret more earnestly the loss of the volumes that contained the whole record.

* * * * * * * * * *

Along the valley of Oil creek are clear traces of ancient operations. Over sections embracing hundreds of acres in extent, the surface of the land has, at some remote period of time, been excavated in the form of oblong pits, from four by six, to six by eight feet in size. These pits are often from four to six feet still in depth, notwithstanding the action of rain and frost for so many years. Some of these pits appear to have been of a circular or oval form, but all to have been excavated with care, and with reference to one design. They are found in the oil region, and over the oil deposits, and in no other place; affording unmistakable evidence of their design and use. The deeper and larger pits appear to have been cribbed up with timber at the sides, in order to preserve their form, and better to adapt them to the end in view; this cribbing was roughly done. The timber was deprived of its bark, halved, and rudely adjusted at the corners. In one instance, as workmen were excavating the earth preparatory to the erection of a saw mill, in a soft, marshy place, one of these circular pits was discovered in the form of a well, perhaps four feet in diameter, with the walls lined with timber set up vertically. These timbers were twelve feet in length, indicating a well of that depth. This well, of course, was filled up nearly to the surface with mud and sediment; but indicating the same design as those before described. The timber had the bark removed, but was apparently sound and free from decay. In the immediate neighborhood of this well there is about an acre covered with these ancient works. In one of these a tree was felled, upon the stump of which eighty concentric circles or growths were counted, indicating its probable age. This was half a century ago. [1815] This record of forest trees is not unfrequent among these oil pits. Farther up the creek, upon the septa that divide them, and even in the pits themselves, trees have grown up more than one foot and a half in diameter, with as many as two hundred of these growths, indicating an antiquity ante-dating the earliest records of civilized life in this region. * * *

By whom were these excavations planned and these pits fashioned, that tell of the search for, and the collection of, petroleum so many years ago? Let the mighty dead that are slumbering in our valleys, and the remnants of whose fortifications and cities are yet scattered all over the great West, arise and speak, for they alone of mortals can tell.

* * * * * * *

From the fact that some of these pits have been cribbed with timber bearing marks of a cutting instrument in its adjustment, many have assigned them a modern origin, and supposed that their construction was due to the French, who, at one time, [say from 1750 to 1760] occupied to a certain extent the Venango oil region. But this theory is scarcely plausible, and certainly not tenable. * * * * * * * There is evidence from the growth of timber in the very beds of these excavations, that they claim an antiquity greater far than the occupation of these valleys by the French. * *

Besides this, where was the market for the immense quantity of petroleum that must have been produced from these excavations, on the supposition that they were constructed by the French? Surely not in Canada or France, for neither in the misty traditions, nor early records of that time, do we find reference to any large quantity of this product; nor had they the facilities for conveying it to the seaboard, had there been a demand for it at home. * * *

Another objection that is fatal to this theory is, that, at this time, the Indians were exceedingly jealous of the encroachments of the pale faces. They watched their movements with the most unslumbering vigilance. The homes of their children, and the graves of their fathers were in danger; and it is beyond the bounds of credulity to suppose that they would have permitted them to carry on these operations for years, turning up the soil, cutting down the timber and, desecrating their hunting grounds, when their overpowering numbers could easily have prevented it at any time. At a much later day the Indians claimed this unguent as one of the special gifts of the Great Spirit to his red children, and they would have as readily tolerated the driving away of their game, and the destruction of their corn, as the carrying away the "medicine" given them to heal their wounds, and anoint their joints for the wilderness march, and adorn their bodies for the war path.

Another theory, that has been somewhat popular, is, that these pits are due to the labors of the American Indians. But the very term labor seems absurd when used in reference to these lords of the forest. They never employed themselves in manual labor of any kind. They scorned it as unworthy of their dignity and independence. * * * They had no implements in their possession when first known to the civilized world, either for excavating or for cribbing the work when excavated, and it is preposterous to suppose that their civilization was of a higher type, or their knowledge of the arts more extensive at any former period of their history.

Beyond all doubt the Indians were well acquainted with the existence and many of the properties of petroleum. That they valued it is beyond a question. They used it both for medicinal and for toilet purposes. But they knew of its existence and production just as the earlier white settlers did: they found it bubbling up from the bed of the stream, and from the marshy places along its banks. They no doubt collected it in small quantities, without labor and without much forethought, and with this small supply were content. The surface oil would more than answer all their purposes. * * * * * * *

The remains of the once powerful confederacy of Indians known as the "Six Nations" still linger in Western Pennsylvania, in a region not very remote from Oil Creek, and at the time this region was settled by the present inhabitants were found in great numbers, but they can throw no light upon the origin of these pits. * * * *

There are men still living in the oil valley who were on terms of familiar intimacy with Cornplanter, [born about 1735, died 1836,] a celebrated chief of the Senecas—the last of a noble and heroic line of chieftains that had borne sway from the Canadas to the Mississippi,—and who was living at the time of the French occupation of the country. * * * His home during the last years of his life was on the Allegheny, about seventy miles above Franklin.* * * For nearly a century he had had intercourse with the chiefs and braves of different tribes, and was well versed in their traditionary lore ; but in reciting his own deeds and memories, and those of his fathers who had gone to the silent hunting grounds of the spirit land, he could say nothing of the early oil operations, any further than the collection of it in small quantities for medicinal or ornamental purposes. Of French operations on Oil Creek he could say nothing, and on the origin of these pits he could throw no light. This would be inexplicable on the theory that they were due either to French or Indian labor. * * * * * *

The only rational conclusion, therefore, at which we can arrive in regard to these early oil operations is, that they are due, not to the Indians, or French, or early white settlers, but to some primitive dwellers on the soil, who have long since passed away, leaving no written records to tell of their origin or their history."

1807. "Mr. F. Cuming in his "Sketches of a Tour to the Western Country," in the summer of 1807, informs us that (*a*) "the virtues of Seneca oil are similar to those of British oil and supposed to be equally valuable in the cure of rheumatic and other pains. Large quantities being collected on Oil Creek, a branch of the Allegheny river, and sold at from one dollar and a half to two dollars per gallon. The mode of collecting it is this: the place where it is found bubbling up in the creek is surrounded by a wall or dam to a narrow compass, a man then takes a blanket, flannel, or other woolen cloth, to which the oil adheres, and spreading over the surface of the enclosed pond, presses it down a little, then draws it up, and running the cloth through his hands, squeezes out the oil into a vessel prepared for the purpose ; thus twenty

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(*a*) Buck.

or thirty gallons of pure oil can be obtained in two or three days by one man."

He also says "About a mile above Little Beaver, in the bed of the Ohio, and near the northwestern side, a substance bubbles up and may be collected at particular times on the surface of the water, similar to Seneca oil. When the water is not too high, it can be strongly smelt while crossing the river at Georgetown."

1808. The U. S. Census "Report on the Production, Technology and Uses of Petroleum and its Products," by Prof. S. F. Peckham, Special Agent, Washington, 1885, contains on page 6 an interesting account of the first *drilled* salt well west of the Alleghenies. It was located on the Great Kanawha a few hundred yards from Campbell's Creek and not far from Charleston, Kanawha County, W. Va. Work upon it commenced in 1806. but the undertaking was a novel one to those engaged in it, and unexpected difficulties were encountered which delayed its completion until January 1808, when a strong vein of salt water was struck at a depth of 58 feet from the surface. The first 18 feet was accomplished by slowly digging through the surface deposits and settling a "gum" made from a hollow sycamore tree 4 feet in internal diameter and 18 feet long to the bed rock; then a 2¼ inch hole was sunk 40 feet into solid rock by means of an improvised set of drilling tools operated by a spring pole.

On page 8 it is stated on the authority of Dr. S. P. Hildreth, of Marietta, Ohio, that—"On the Muskingum river the wells afford but little oil, and that only during the time the process of boring is going on; it ceases soon after the wells are completed, and yet all of them abound more or less in gas. A well on Duck Creek, about 30 miles north of Marietta, owned by Mr. McKee, furnishes the greatest quantity of any in this region. It was dug in the year 1814, and is 475 feet in depth"

Several wells were bored for salt in Kentucky and Tennessee prior to 1820, "in which petroleum appeared in sufficient quantity to be troublesome."

The famous "American Well" was bored near Burkesville, Cumberland County, Kentucky, in 1829; of which a writer in *Niles' Register* says:

"Some months since in the act of boring for salt water on the land of Mr. Lemuel Stockton, situated in the County of Cumberland, Ky., a vein of pure oil was struck, from which it is almost incredible what quantities of the substance issued. The discharges were by floods, at intervals of from two to five minutes, at each flow vomiting forth many barrels of pure oil. These floods continued for three or four weeks, when they subsided to a constant stream, affording many thousand gallons per day."

The oil found its way into the Cumberland river, and having been set on fire is said to have burned upon its surface to a distance of more than 40 miles below the well.

These extracts are given to show that large quantities of oil were produced by wells *drilled* several hundred feet in depth, long before drilling was thought of on Oil Creek. We now return to Pennsylvania history.

1810 to 1815? Rev. S. J. M. Eaton, of Franklin, (*a*) gives a very interesting account of the early methods of collecting and marketing petroleum on Oil Creek; from which the following extracts are taken. The exact dates are not given, but they probably come within the years named above.

"A point was selected where the oil appeared to bubble up most freely, when a pit was excavated to a depth of two or three feet. Sometimes this pit was rudely walled up, sometimes not. Sometimes it was near the edge of the water on the bank of the stream, sometimes in the bed of the stream itself, advantage being taken of a time of low water. In these pits the oil and water would collect together, until a stratum of the former would form upon the surface of the latter, when a coarse blanket or piece of flannel was thrown in. This blanket soon became saturated with oil, but rejected the water. The blanket was then taken out, wrung into a tub or barrel, and the operation repeated."

(*a*) **Petroleum: A History of the Oil Regions of Venango Co., Pa. p. 56 &c.**

"The first shipment of petroleum was to Pittsburgh, and on this wise. Mr. Cary, one of the first settlers on Oil Creek, possessing perhaps a little more enterprise than his neighbors, would collect or purchase a cargo of oil and proceed to Pittsburgh, and exchange it for commodities needed in his family. This cargo consisted of two five gallon kegs, that were slung one on each side of a horse, and thus conveyed by land a distance of seventy or eighty miles. * * Sometimes the market in Pittsburgh became very dull, for a flatboatman would occasionally introduce a barrel or two at once, that he had brought down on his raft of lumber or logs. At other times the demand fell off, so that the purchase of a barrel was hazardous."

"At a period somewhat later than this, Gen. Samuel Hays, who settled here in 1803, relates that at one time he purchased all the oil produced in the country, and that the highest annual yield was sixteen barrels. This oil he sold at the time in Pittsburgh at about one dollar per gallon."

1821 Natural gas first used in a small way in lighting houses at Fredonia, Chautauqua Co., N. Y. (Penna. Geol. Survey, Report L, p. 170)

1828 The following letter was published in the Pittsburgh Gazette in 1828, (Buck)

"I see that the corporation has at last determined to light the city. It is a very sensible determination; for indeed few places need it more. I fear that lighting with gas will be found troublesome and expensive in spite of the vast supply and cheapness of coal; but I will tell you what is the cheapest, best and most economical light you can use; it is what is called in the West Seneca oil, which is Petroleum. This substance, were there a ready market for it, might be supplied at your very doors to an almost unlimited extent. At present it is almost useless, being used only as an ingredient in what is called "British oil," and as a horse medicine (in which, by the by, it is very useful.) The price of it is very low, because a few barrels glut the demands of the apothecaries; but if the city would take a large quantity, or if it were brought into use otherwise, I think it could be supplied at twenty-five cents per gallon.

The salt wells may be cleared of what floats by letting a blanket down every quarter of an hour, and this will also apply to the springs where it is discovered. Let any one who doubts that it is a perfectly good oil for lamps, send to the apothecary's for half-a-pint, and burn it one night in a lamp of any kind, precisely as fish or spermaceti oils are burned, observing only that to avoid smoke, it is necessary the length of the wick should be diminished. I have tried it, and found it to succeed perfectly, and there is no reason why it should not be clarified as well as any other oil (and then it will burn as free from smoke) by filtering or precipitating the gross particles contained in what is now brought to market. If Seneca oil will supply more gas than animal oils, which I do not doubt, and if it can be procured at twenty-five cents per gallon, a fair trial of it in this way would assuredly be demanded by common prudence."

1833. From an article written by Prof. B. Silliman, Sr., after a visit to the "Cuba oil spring" and published in the "American Journal of Science" in 1833, we make the following quotations:

"The oil spring, as it is called, is situated in the western part of the County of Allegany, in the State of New York, * * * * very near the line which divides Allegany and Cattaraugus. * * * * * *

The Oil Spring or fountain rises in the midst of a marshy ground. It is a muddy and dirty pool of about eighteen feet in diameter, and is nearly circular in form.

There is no outlet above ground, no stream flowing from it; and it is of course a stagnant water, with no other circulation than that which springs from the changes of temperature and from the gas and petroleum that are constantly rising on the surface of the pool. The water is covered with a thin layer of petroleum or mineral oil, giving it a foul appearance as if coated with dirty molasses, having a yellowish-brown color. Every part of the water was covered by this film. * * * * All the sticks and leaves, and the ground itself around the fountain, are rendered more or less adhesive by the petroleum.

They collect the petroleum by skimming it like cream from a milk-pan. For this purpose they use a broad, flat board, made thin on one edge like a knife. It is moved flat upon and just under the surface of the water, and is soon covered by a coating of petroleum which is so thick and adhesive that it does not fall off, but is removed by scraping the instrument upon the lip of a cup. It has then a very foul appearance like very dirty tar or molasses, but it is purified by heating it, and straining it while hot through flannel or other woolen stuff. It is used by the people of the vicinity for sprains and rheumatism, and for sores upon their horses. It is not monopolized by any one, but is carried away freely by all who come to collect it, and for this purpose the spring is frequently visited. I could not ascertain how much is annually obtained; but the quantity is considerable. * * * *

The history of this spring is not distinctly known. The Indians were well acquainted with it, and a square mile around it is still reserved for the Senecas. * * *

I cannot learn that any considerable part of the large quantity of petroleum used in the Eastern States under the name of Seneca Oil comes from the spring now described. I am assured that its source is about one hundred miles from Pittsburgh, on the Oil Creek which empties into the Allegheny river in the township and County of Venango. It exists there in great abundance, and rises in purity to the surface of the water. By dams enclosing certain parts of the river or creek it is prevented from flowing away, and is absorbed in blankets from which it is wrung."

1843. In Charles B. Tergo's "Geography of Pennsylvania," published in 1843, Mr. Buck says the following is to be found.

"Oil Creek derives its name from the substance called Seneca oil, which rises in bubbles from the bed of the stream, and on reaching the top of the water these bubbles explode, leaving the oil floating on the surface. Though this oil is found in many places throughout the whole course of the stream, it is most abundant two or three miles from the mouth. Several of the owners of the land make a business of collecting the oil during the dry season, as it is most plentiful at low water. From two to ten or twelve barrels are collected in a season by the proprietors; the quantity depending on the prevalence of dry weather and low water. In the low grounds along this creek, oil may be obtained by digging to a level with the bottom of the stream, but when thus procured it is not so pure and clean as that taken upon the surface of the creek. This mode of obtaining it has evidently been practiced by the Indians, or some other people, long before the white man set his foot upon the soil of this region. Places of four or five acres in extent may still be seen, where holes have been dug in the ground from six to twelve feet in diameter, close together, being yet from two to four feet deep, and having trees standing on many of them of upwards of one hundred years' growth. On the settlement of this part of the country, some of the oldest Indian residents were questioned respecting these excavations, but were unable to give any information concerning them. The medical qualities of this oil have been much extolled. Forty or fifty years ago it was sold at sixteen dollars per gallon; but its present price in Pittsburgh is from seventy-five cents to one dollar."

1845 The following items of interest are found in a small book published in Philadelphia in 1865, entitled, "Petroleum and Petroleum Wells" by J. H. A. Bone; they are given without any reference, as if derived from original sources.

"In the year 1845, Mr. Lewis Peterson Sr. of Tarentum, Allegheny County, Pa. brought to the Hope Cotton Factory, at Pittsburgh, a sample, in a bottle, of what is now known as petroleum. It came up with the salt water from his salt well at Tarentum, and gave him considerable trouble. Mr. Morrison Foster, then of Pittsburgh, but now [1865] of Cleveland, in conjunction with the manager of the spinning department of the mill, Mr. David Anderson, experimented with the oil, and soon found that by a certain process it could be combined with sperm oil, in such a way as to form a better lubricator for the finest cotton spindles than the best sperm oil, which alone could previously be used for that purpose. The mixture cost about seventy cents per gallon, whilst the sperm oil alone cost one dollar and thirty cents. The saving was so great, in one of the heavy items of expense in a large cotton factory, that a contract was entered into with Mr. Peterson, by which the latter was to supply two barrels per week; and for ten years this oil continued to be used at the Hope Cotton Factory, unknown to any one but the proprietors.

A few years afterwards, Mr. Kier, who also had salt wells at Tarentum, and was troubled, like Mr. Peterson, by the oil that came up with the water sent some of the oil to Prof. Booth, of Philadelphia, for analyzation. Acting on the advice of Prof. Booth, Mr. Kier took some of the oil to New York and experimented with it as a solvent for gutta percha. Failing in this, he was induced by Prof. Booth to try its merits as an illuminator, and succeeded in refining it so that it was used as "Carbon Oil" in Pittsburgh from 1850 to 1855; meeting with a sale that required all the oil to be obtained from the salt wells at Tarentum to supply the demand."

1849? About this time Mr. Kier opened an establishment in Pittsburgh where petroleum was put up in half-pints and sold at 50 cents per bottle, labeled as follows: (a) "*Kier's Petroleum, or Rock Oil, Celebrated for its Wonderful Curative Powers. A Natural Remedy! Procured from a Well in Allegheny Co. Pa., Four Hundred Feet below the Earth's Surface. Put up and Sold by Samuel M. Kier, 363 Liberty Street, Pittsburgh, Pa.*

"The healthful balm, from Nature's secret spring,
The bloom of health and life to man will bring;
As from her depths the magic liquid flows,
To calm our sufferings, and assuage our woes."

On one of his circulars printed to resemble a bank note he says: "A. D. 1848, discovered in boring for salt water—A. D. 1849 wonderful medical virtues discovered." The "Bank Note" is dated Jan. 1, 1852.

(a) "The Early and Later History of Petroleum" p. 56

1853 The following, (from page 60 as above) appears to be the first oil lease on record.

"Agreed this fourth day of July, A. D. 1853, with J. D. Angier of Cherry Tree township, in the County of Venango, Pa. that he shall repair up and keep in order the old oil spring on land in said Cherry Tree Township, or dig and make new springs, and the expenses to be deducted out of the proceeds of the oil, and the balance, if any, to be equally divided, the one-half to J. D. Angier and the other half to Brewer, Watson & Co., for the full term of five years from this date. If profitable."

"BREWER, WATSON & CO.
"J. D. ANGIER."

Under this agreement Mr. Angier proceeded to dig ditches and pits and in doing so frequently struck "pockets" of oil, (some of which contained a quart) in the gravel three or four feet beneath the surface. When the ditches were first opened, from four to six gallons per day could be collected, but so much work was required to keep the oil flowing, that the expenses consumed the profits and after a few months the experiment was abandoned.

1854. The deed of the first property sold for oil purposes in Pennsylvania, was made by Brewer, Watson & Co. of Titusville, and conveyed to George H. Bissell and Jonathan G. Eveleth of New York, one hundred and five acres of land in Cherry Tree township, Venango Co. Pa. Actual consideration $5,000; ($25,000 was mentioned in the deed). Dated Nov. 10th 1854; but not fully executed until Jan. 1st 1855.

The land was purchased for the purpose of forming a Company and raising capital to thoroughly ditch and develop for surface oil, and the idea of *drilling* for it did not occur to the proprietors until the summer of 1856, when Mr. Bissell accidentally came across one of Mr. Kier's circulars showing that rock oil had been obtained in Allegheny County at a depth of 400 feet.

1855. On the 30th of December 1854, The Pennsylvania Rock Oil Company was organized under the laws of the State of New York, and the Certificate of Incorpora-

> tion filed both at Albany and in New York City."
> "The objects for which said Company is formed, are to raise, procure, manufacture and sell Rock Oil."
> "The capital stock shall be two hundred and fifty thousand dollars. The business shall commence on the first day of January 1855, and continue fifty years." The land to be developed was the 105 acres mentioned above. The Trustees named for the year 1855, were as follows: "George H. Bissell, J. G. Eveleth, Franklin Reed, James A. Salisbury and Dexter A. Hawkins, of New York, Francis B. Brewer of Titusville, Pa. and Anson Sheldon of New Haven, Conn."

Thus came into existence the first company organized expressly to prospect for oil in Pennsylvania. Several gallons of petroleum collected from the ditches had already been sent to Prof. B. Silliman, Jr., of Yale College, for analysis; and when his elaborate report was made public in April 1855, (*a*) it created a very favorable impression among capitalists in the Eastern States, but they hesitated to subscribe to the stock of a company organized under the laws of New York. Therefore a new Company—still retaining the old title, but with a capital of $300,000—was formed in New Haven under the laws of Connecticut, Sept. 18th, 1855. Fortunately, Messrs. Bissell and Eveleth had not yet recorded the deed of conveyance to the old company, and having now ascertained that foreign corporations could not hold land in fee in Pennsylvania, they "executed a deed to Asahel Pierpont and William A. Ives, of New Haven, who gave a bond for the value of the property and promptly *leased* it for ninety-nine years, to the new company."

The members of the new company were inharmonious and but little was done at the oil springs. In October, Dr. Brewer speaks of a new trench from which Mr. Angier took six gallons of oil, although it had been gathered the day before. He also says, "from 50 to 100 gallons per day may

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(*a*) See Early and Later History of Petroleum, (pp 88 &c) from which the most of this history has been obtained.

be had by the judicious expenditure of five hundred dollars."

1856. In the summer of this year, Mr. Bissell, happening to notice one of Mr. Kier's circulars,—as mentioned above—conceived the idea of *drilling* for oil at Titusville and consulted with Mr. Eveleth, who favored the project. Not being so situated that they could undertake the experiment themselves, they mentioned the matter to Mr. Havens of New York, who became so favorably impressed that he offered them $500 if they would secure him a lease of the property of the Pennsylvania Rock Oil Co.—Here, in parenthesis, we pause to notice that the oil lease *bonus*, now so common, evidently ante-dates the first oil well.—After considerable delay the lease was obtained. Havens was required to pay 12 cts. per gallon for all the oil raised in 15 years, and given one year to commence operations in. He did not comply with the terms; and on Dec. 30, 1857, another lease was made by the New Haven directors, contrary to the wishes of the others, to E. E. Bowditch and E. L. Drake, at a royalty of *five* and *a-half cents* per gallon, but this was soon supplemented by another restoring the royalty to 12 cts. and extending the time to 45 years. On this lease the "Seneca Oil Company" was formed March 23rd 1858, which had the honor of drilling the Drake well,—the first "Wild Cat" in the Pennsylvania oil regions.

1858. Mr. Drake, as Superintendent of the Seneca Oil Co. arrived in Titusville early in May 1858, started up the abandoned works of the old company, and commenced to cast about for some one to drill a well. In July he collected about ten gallons of oil per day from the ditches. In August he shipped two barrels to New Haven. Failing to dig a well to solid rock, he had commenced to build a drill house, ordered an engine and engaged a driller, expecting to commence boring in September. But the engine was not ready on time, his funds failed to come to hand and the work had to be postponed for the winter.

1859. In February Drake went to Tarentum and engaged a driller to come up and commence his well in April. He neglected to come, however, and Drake was obliged to make a second visit, when he secured the services of "Uncle Billy Smith," who, with his two sons arrived in Titusville about the middle of June. In the Tarentum wells the custom was to dig a pit to the bed rock before commencing to drill. But here, on account of the great depth of superficial deposits below water level, that plan failed, and Mr. Drake determined to drive down an iron pipe. This he finally accomplished successfully, finding "bed rock" at 36 feet. The drill was started about the middle of August and on the afternoon of Saturday August the 28th a vein of oil was struck at a depth of 69½ feet. The oil rose to within about 10 ft of the surface and when the well was equipped for pumping it produced about 25 barrels per day, which gradually fell off to about 15 barrels at the close of the year. As no other well was completed during this time, the production of the Pennsylvania oil regions for 1859 could not have exceeded 2,000 barrels, although it is sometimes quoted at 82,000.

From this small beginning in the backwoods of Venango County, has grown the great petroleum industry which now gives employment to tens of thousands of men in its several departments of production, piping, refining and shipping, and yields an annual revenue of many million dollars.

A history of the succeeding years would be full of interest, but each year requires a volume ; We can only note a few of the important events in chronological order to show how oil development gradually expanded.

1860. Drilling, principally by spring-pole, very active along the low lands of Oil Creek, French Creek and Allegheny river. Oil found at Tidioute, Henrys Bend, Franklin and Smiths Ferry. Production for the year about 200,000 barrels.

1861. First flowing well obtained on Oil Creek ; said to be the first well drilled to the "Third Sand"; but this is a mistake, for the Tidioute wells were drilled into it the year before. The early drillers were not aware that the rocks dipped towards the southwest, and as the Tidioute wells were only about 100 feet deep while Funk's flowing well was 460 feet, quite naturally concluded they had found a sand that had never been pierced by shallow wells.

This was the flowing-well year. Several wells spouted from 2,000 to 2,500 barrels per day. The creek bottoms were covered with oil, and thousands of barrels were sold as low as five cents per barrel; and even at that price many of the purchasers lost money.

1862. Nothing new developed. Operations confined to Oil Creek, French Creek, Allegheny river and Smiths Ferry.

1863. Ditto.

1864. Cherry Run the centre of attraction. Great oil excitement throughout the country. Every part of the known oil region purchased or leased by Oil Companies. Oil in July $13 75 per barrel.

1865. Great freshet and much property destroyed in Feb. Collapse of many of the speculative oil bubbles. Pithole pool discovered and Pithole city built. Wells obtained at Church Run, Fosters, and several other places in the old fields, and a small well near Parkers in Armstrong County. Oil excitement on Dunkard Creek, in Greene County.

Late in this year the first pipe line was laid to convey oil from Pithole to Miller farm. More than 1,000 teamsters had up to this time found employment in hauling oil from Pithole to the several points of shipment, charging, sometimes, as high as three dollars per barrel. When thrown out of work they became very turbulent and the pipe line had to be patrolled by armed guards for several weeks to prevent them from tearing it up. This marks the commencement of a new era in the transportation of oil. Other pipe lines were quickly laid, and in a short time the barreling and hauling of oil faded into the history of the past.

1866. Small well struck in Clarion County and one at

Brady's Bend—giving notice of a probable extension of oil territory in that direction. Operators begin to leave the flats and drill on the uplands of Stevenson, Wood and other farms.

1867. Dennis Run, Triumph, Shamburg and Scrubgrass added to the producing list.

1868. Pleasantville developed. Butler and Clarion commencing to open up. A small well at Bradford, but considered of no significance.

1869. Attention directed principally to Butler, Armstrong and Clarion. Church Run developments active.

1870. Colorado developing. Engines at Gas City run by natural gas introduced into their cylinders directly from a large gas well in Pine Grove township, Venango Co.

1871. Developments on the "Angel Belt Line" at Reno, Milton farm, Bully Hill and Mount Hope.

1872. Newton Gas well struck, and gas piped 5¼ miles to Titusville and furnished for fuel and light to about 250 customers. This undoubtedly was the first natural gas plant of the kind in the country. A two inch line was first laid, but failing to deliver in sufficient quantity, it was reinforced by a 3¼ inch pipe which conveyed the gas satisfactorily.

1873. Butler, Armstrong and Clarion rapidly developing, and production increasing largely.

1874. Natural gas first used in iron making by Messrs. Rogers & Birchfield, at Leechburg. (L. p. 162.)

1875. Butler, Armstrong and Clarion still the center of operations. Some attention directed to Bradford.

First well drilled at Warren.

1876. Bradford, Warren and Bullion Run add 500,000 barrels of new production this year. A six inch gas main laid from the Harvey well in Butler County to Sharpsburg—17 miles—and natural gas successfully applied to iron working in Messrs. Spang, Chalfant & Company's Etna Mill. The line was also continued two miles farther to the mills of Messrs. Graff, Bennett & Co, at Millvale.

1877. A well at Balltown and another at Foxburgh, in Forest County show considerable oil; but the tide of development sets towards Bradford, and little attention is paid to Forest County until 1882 when the Balltown and Cooper pools are discovered near these wells.

1878. First well at Stoneham, Warren Co. Bradford developing rapidly. Haymaker Well No. 1 struck at Murraysville, Westmoreland Co. This was the first great gas well on the now famous Murraysville gas belt. It is still flowing largely, but its product was not turned into the Pittsburgh pipe lines until 1884.

1879. First small well in Allegany County N. Y. but considered of little importance. Tide-Water pipe line completed from the Bradford oil field to Williamsport in Lycoming County, a distance of over 100 miles. This was the first attempt to pipe oil to the seaboard; and as it threatened to injure the carrying trade of the Railroads, met with great opposition during its construction. But when completed and put in successful operation, the advantages of this method of transportation became so apparent, that opposition ceased, and other lines were quickly laid so that oil is now piped directly from the oil regions to New York, Philadelphia and Baltimore.

1880. First well at Clarendon. Bradford the great field of operations.

1881. Allegany, N. Y. under very rapid development. Bradford at its maximum and its producing area pretty thoroughly outlined.

1882. Cherry Grove in Warren County, flashes up in four months to a production of 40,000 barrels per day, and as quickly fades into insignificance. Allegany at its maximum. Bradford on the decline. McGuigan Gas Well struck in Washington County.

1883. Cooper and Balltown producing largely, in Forest County. Bradford and Allegany steadily declining. Attention begins to be directed towards supplying natural gas to Pittsburgh, and several wells are drilled in that vicinity.

1884. Baldridge and Thorn Creek in Butler Co. opened up. Wardwell and Clarendon in Warren County and Cooper and Balltown producing largely. Ford & Nelson's gas line laid from the McGuigan well in Washington Co. to Painter & Sons' iron mills, South Side, Pittsburgh, Pew & Emerson's gas line laid from Murraysville to East Liberty, and the Acme Gas Co.'s line put in operation between Lyons Run and the Edgar Thompson Steel Works at Braddocks. Several gas wells obtained in the City of Pittsburg, at Homewood; Westinghouse No. 1 starting off with astonishing power. A system of local pipe lines laid to utilize the gas. Borough of Washington in Washington County supplied with natural gas from wells in the neighborhood.

1885. Cogley Run and Red Valley pools discovered, Thorn Creek and Clarendon in their prime, all other districts declining. The first oil well in Washington County—the Gantz well, at Washington—struck oil Jan. 1, 1885, but no important developments until the following year. Natural gas lines from Murraysville, Tarentum and Washington County to Pittsburgh, rapidly entering the city.

1886 Washington, Shannopin, Kane, Tarkill, Grand Valley and several small pools added to the producing territory, and the annual production of oil increased over the previous year by about four and a half million barrels.

The following summary shows the quantity of oil produced in the Pennsylvania and New York oil fields down to the close of 1886. It is divided into 7 periods of 4 years each.

1859–1862.	Total	production,	5 367,000	bbls
1863–1866.	"	"	11,193,000	"
1867–1870.	"	"	17,021,000	"
1870–1874.	"	"	32,703,000	"
1875–1878.	"	"	46,226,000	"
1879–1882.	"	"	103,578,000	"
1883–1886.	"	"	94,135,505	"
1859–1886.	"	"	310.218,505	"

This production has exceeded the demand and we now have about 33,000,000 barrels of crude above ground and stored in iron tanks.

The maximum annual production was in 1882, . . 30,460,000 bbls
The total production for 1886 was, ... 25,436,000 "

Of the twenty-one counties mentioned at the head of Chapter II, ten were pretty thoroughly developed prior to 1884. Some of these have produced immense quantities of petroleum, and furnished many powerful and enduring gas wells. Arranged according to the volume of their production they would stand as follows:

1. McKean, Very large production.
2. Venango, " " "
3. Butler, " " "
4. Clarion, Large production.
5. Warren, " "
6. Forest, Moderate production, Small area.
7. Crawford, " " " "
8. Armstrong, " " " "
9. *Beaver, " " " "
10. Lawrence, Small " " "

These are the counties that have produced about 300,000,000 barrels of oil during the last 28 years.

To understand the situation in the remaining counties they must be reviewed in detail.

11. *Potter.*—Some fair gas wells, which are being utilized, in the northwestern portion of the county. Many unsuccessful test wells drilled in other parts, with some show of oil.

12. *Erie.*—Scores of low-pressure gas wells in the city of Erie and along the Lake Shore; occasionally one producing two or three barrels of oil per day; an unprofitable territory, nevertheless, for the oil seeker.

13. *Mercer.*—A few small oil wells near Sandy Lake. Considerable drilling has been done in other parts of the county, unrewarded by the discovery of either oil or gas, in paying quantities.

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*Beaver has largely increased its oil production during the last year, and also become a great gas field.

14. *Elk.*—Here a number of small oil wells and some very strong gas wells have been obtained after considerable wildcatting. As yet, however, the production is very small and the future of the field undetermined.

15. *Jefferson.*—Several small gas wells, some indications of oil, but nothing very promising at present.

16. *Indiana.*—A large gas well in the northern part which supplies the town of Punxutawney. This gas comes from a very deep sand, and what its significance may be remains for future developments to demonstrate.

17. *Allegheny.*—Many large gas wells and considerable oil production in the western part. The developments are comparatively new, and still being pushed forward successfully.

18. *Westmoreland.*—This county contains the great Murraysville and Grapeville gas belts—the largest storehouses of natural gas yet discovered in the country. Over seventy-five wells are now contributing to the demands of Pittsburgh, Johnstown, Appolo, and other towns within their reach. Some small oil wells have been obtained in the county, but as far as can be judged at present, the indications do not encourage the hope of finding a large oil field here.

19. *Washington.*—The new oil and gas field of 1886. Large flowing oil wells, and gas wells of tremendous power and volume. Developments still being prosecuted successfully.

20. *Greene.*—Extensive oil developments on Dunkard creek, near West Virginia line, in 1865. The wells were shallow, and a few produced largely. Several deep wells have recently been drilled in this county, and oil obtained in deeper sands than those reached by the early wells.

21. *Fayette.*—Many shallow wells from 300′ to 600′ deep have been drilled here, making excellent shows of gas, and in some cases, oil. Within the last two years, deeper drilling has disclosed other oil and gas horizons, but so far the quantity of oil is unimportant, and the gas flows are small as compared with Westmoreland and Washington.

CHAPTER II.

Geography and Topography.

In a general description of the geography, topography and drainage of the Pennsylvania oil and gas regions twenty-one counties are to be included. It is true that only about half that number are largely productive, but the others are none the less entitled to recognition, for all of them have furnished productive wells, either of oil or of gas. These counties lie west of the Allegheny Mountains, and occupy the entire width of the State, as follows:

Erie,	**Area**	**770**	**square**	**miles.***
Crawford,	“	**1000**	“	“
Warren,	“	**910**	“	“
McKean,	“	**1000**	“	“
Potter,	“	**1070**	“	“
Mercer,	“	**660**	“	“
Venango,	“	**660**	“	“
Forest,	“	**430**	“	“
Elk,	“	**770**	“	“
Clarion,	“	**570**	“	“
Jefferson,	“	**640**	“	“
Lawrence,	“	**370**	“	“
Butler,	“	**820**	“	“
Armstrong,	“	**610**	“	“
Indiana,	“	**830**	“	“
Beaver,	“	**450**	“	“
Washington,	“	**890**	“	“
Allegheny,	“	**760**	“	“
Westmoreland,	“	**1040**	“	“
Greene,	“	**620**	“	“
Fayette,	“	**830**	“	“
Total,		**15700**		

***From Tenth Census Report.**

The three counties of Chautauqua, Cattaraugus and Allegany, in New York, still further extend the oil and gas fields towards the north.

Nearly all this large area is drained by tributaries of the Ohio river. About half of Erie county contributes to Lake

Erie, and small portions of Washington and Greene to the Ohio after it leaves the State. Potter divides its rainfall between the rivers Allegheny, Genesee and Susquehanna; and Elk lies partly on the Susquehanna watershed. With these exceptions, all the surplus waters of the region find their way through the Allegheny, Monongahela, Beaver, and their branches, into the Ohio river, and pass out of the State through Beaver county in one common channel.

The northerly rim of this great water-basin is the "Lake Erie Divide," which, in Crawford and Erie counties, ranges in its highest parts from 1200′ to 1600′ above ocean level. In Cattaraugus county, N. Y., it attains an altitude of 2500′ in several places, and thence sweeping around easterly and southeasterly to the "Continental Divide" in Potter county, Pa., rises to over 2600′—this being the highest point of which we have positive knowledge within the twenty-one counties named. Southerly from this summit the general surface of the watershed between the Allegheny and the Susquehanna gradually lowers towards the low and narrow divide between Red Bank Creek and Bennett's Branch of the Sinnemahoning, in the northwest corner of Clearfield county, as seen by the following levels. Keating Summit, on Buffalo, New York & Philadelphia R. R., near west line of Potter county, 1878′. Hills to the northeast about 2475′. Hills to the southwest 2350′ to 2150′. St. Mary's Summit, Philadelphia & Erie R. R., near centre of Elk county, 1696.′ Hills southwest, 2250′ to 1800′. Low grade R. R. summit, northwest corner of Clearfield county, 1406′.

Thence southerly the divide soon rises to 2000′, sweeping around to the southeast corner of Jefferson county, and passing through the northeasterly part of Indiana, where it takes a southeasterly course through Cambria Co. to Gallitzin, on the Penna. R. R. In Cambria Co. the levels vary from 2000′ to 2600′, and the railway mounts the summit at Gallitzin 2161′ above the ocean.

Thence southerly to the West Virginia line, the crest of the Allegheny mountain, ranging in height from 2500′ to 2850′, forms the eastern boundary of this part of the water-basin, and includes the larger parts of two counties, (Cambria and Somerset) in addition to those under review.

The Allegheny carries all the drainage south of the "Lake Erie Divide" in New York, the Monongahela and Youghiogheny rise far south in the mountains of Maryland and West Virginia, and the Mahoning and other western branches of Beaver river drain large areas in Ohio; hence the current which passes down the Ohio and leaves the State near Smith's Ferry is a mixture of waters drawn from Ohio, on the west; New York, on the north; Pennsylvania, in the centre; and Maryland and West Virginia on the south.

The head of the Ohio river, at Pittsburgh, formed by the confluence of the Allegheny, coming from the north, and the Monongahela from the south—is 27 miles east of the State line, and the surface of low water 699′ above ocean level. The Monongahela enters the State 32 miles east of said line at an elevation of about 785′, and the Allegheny 76 miles east at an altitude of 1270′.

Distance from Pittsburgh to West Virginia line at crossing of Monongahela river 52 miles in a direct line S. 5° E.; by windings of river, about 90 miles. Total fall of water 86′ = 1.65′ per mile direct and 0.95′ by river.

Distance from Pittsburgh to New York line at crossing of Allegheny river, 119 miles in a direct line N. 25° E.; by river windings 210 miles. Total fall of water 571′ = 4.80′ per mile direct and 2.72′ by river.

It is seen from the above that the central and deepest lines of drainage in the main basin meet at Pittsburgh—the northern waters falling in their journey nearly three times as fast as the southern. Here the accumulating floods start off towards the northwest, as if destined for Lake Erie; but, after flowing in that direction about 25 miles, are met by the Beaver, coming from the north, deflected southwesterly towards the Mississippi, and leave the State at an elevation of about 665′ above ocean level.

Some idea of the natural slopes of the eastern tributaries may be had by noting the levels of Railroads skirting them. Of course, these do not give the *exact* water levels, but they follow the valleys and plainly show the general features of drainage.

Youghiogheny River. Connellsville, Fayette Co., R. R. level 893′ above ocean; Confluence, Somerset Co. 1346′. Fall to Pittsburgh 647′. Distance in air line 57 miles.

Conemaugh, or Kiskiminetas River. Enters the Allegheny 29 miles above Pittsburgh, at West Penn Junction. Elevation of the Junction 791′. Conemaugh Furnace, Southeast corner of Indiana County, 1135′. Fall 344′. Distance, (direct) 38 miles.

Red Bank Creek.—64 miles above Pittsburgh. R. R. level 851′. Evergreen in eastern part of Jefferson county, 1400′. Fall 549′. Distance (direct) 40 miles.

Clarion River.—83 miles above Pittsburgh. River bridge 889′. Ridgway, Elk county 1393′. Fall 504′. Distance, (direct) 50 miles. St. Mary's summit 1696. Wilcox 1527. Kane, 2021, all on Clarion waters.

Tionesta Creek.—150 miles above Pittsburgh. Tionesta Station 1060′; Sheffield, Warren county, 1344′. Fall, 284′. Distance, (direct) 26 miles. Headwaters at Kane 2021′.

Kinzua Creek.—200 miles above Pittsburgh. Kinzua Station, 1230′. The sources of this stream lie along the "Big Level," about 20 miles to the southeast, at an altitude of about 2000′.

Tunangwant Creek.—238 miles above Pittsburgh. Rises on the "Big Level" in McKean county Pa. and running nearly north about 20 miles, enters the Allegheny near Carrollton, Cattaraugus county, N. Y. Carrollton 1399′. Bradford 1444′. Alton 2087′.

The Allegheny River, as before stated, rises in the highlands of Potter county, Pa. where some of the highest points reach an altitude of over 2600′. At Coudersport, about 15 miles from its source it is 1645′ above ocean. At Olean N. Y., about 45 miles below Coudersport, and 255 miles from Pittsburgh the water level is, (according to Roberts' Survey of the Allegheny River in 1879) 1302′ above ocean, or 703′ above Pittsburgh,—which gives an average fall between these two places, as the river winds, of 2.80′ per mile.

In 1830, the steamboat "Allegheny" built to ply between

Pittsburgh and Warren, made an experimental trip as far as Olean, (and no doubt could have gone several miles farther) thus proving the river to be navigable by steam, at certain stages, to a distance of 255 miles above Pittsburgh.

For about 110 miles above Pittsburgh, the westerly watershed of the Allegheny varies in width from 5 to 15 miles, and ranges in height from 1400′ to 1550′. This margin is too narrow to hold any very important stream, although Buffalo Creek, (which runs southerly through the widest part of it and enters the river nearly opposite the Kiskiminetas,) drains an area over 20 miles in length.

Big Sandy.—113 miles from Pittsburg, and 10 miles below Franklin, heads in the southerly part of Crawford county, about 25 miles northwesterly from where its waters enter the Allegheny, but its belt of drainage is very narrow. It takes the overflow from Sandy Lake, in Mercer county, the elevation of which is 1160′, or about 210′ above the mouth of Big Sandy.

Above Big Sandy are French, Oil, Brokenstraw and Conewango Creeks; all streams of considerable importance, and all, excepting Oil Creek, heading in New York, on the "Lake Erie divide."

French Creek.—123 miles above Pittsburgh. Allegheny Valley Depot at Franklin 988′. Conneaut Lake, Crawford county, 1082′. Fall 94′. Distance, (direct) 28 miles. Conneautee Lake, Erie county, 1196′. Fall 208′. Distance 36 miles. Headwaters of other branches near Sherman, Chautauqua county N. Y. 1568′. Fall 580′. Distance 50 miles. Corry, Erie Co. Pa. 1429′. Fall 441′. Distance 37 miles.

Oil Creek.—131 miles above Pittsburgh. Union Depot Oil City 1008′. Oil Creek Lake 1389′. Fall 381′. Distance, (direct) 26 miles. Sparta Crawford county, northeast corner, 1455′. Fall 447′. Distance 27 miles.

Brokenstraw Creek.—180 miles above Pittsburgh. Irvineton Station 1173′. Clymer Station, Chautauqua county N. Y., 1446′. Fall 273′, Distance, direct 22 miles. Corry, Erie county, Pa. 1429′. Fall 256′. Distance 20 miles. Panama, Chautauqua Co. N. Y. 1552′. Fall 379′. Distance 21 miles. The last is on the Little Brokenstraw which here cuts through the Panama Conglomerate, making the noted "Panama Rock City."

Conewango Creek.—188 miles above Pittsburgh. Railroad Station at Warren 1200′. Chautauqua Lake in N. Y. 1299′. Fall 99′. Distance, (direct) 21 miles. Cassadaga Lake, in N. Y. 1305′. Fall 105′. Distance 35 miles.

Big Beaver River, through its many branches drains a small portion of Western Crawford Co. and nearly all of Mercer, Lawrence and Butler. Its northerly tributaries, the Shenango and Crooked Creek, rise in Pymatuning swamp, just west of Conneaut Lake, and have practically the same source as the westerly branch of French Creek. When the old Beaver Canal was in operation Conneaut Lake was used as the summit reservoir, the water supply being kept up by means of an aqueduct taking water from French Creek a few miles above Meadville. From the lake the water flowed north to lock boats towards Lake Erie, and south to lower them along the headwaters of Beaver towards the Ohio. Elevation of Conneaut Lake 1082′. Ohio, at mouth of Beaver, about 670′. Fall 412′. Distance (direct) 65 miles.

Most of the country occupied by the Allegheny and its eastern branches is wild and rugged. Precipitous cliffs fringe many of the narrow and torturous water-ways —backed by steep slopes, which rise from 300′ to 800′ above the valleys. Frequent escarpments of masssive conglomerate and sandstone are seen, whose weathered fragments cover the slopes below and render large areas unfit for cultivation. This is the general character of the country where the massive sandstones of the carboniferous system come to the surface. But in Erie county, the western part of Warren, in Crawford, Mercer, and parts of Lawrence and Butler, a different type of topography prevails. Here the valleys are broad, the streams loop from side to side, flowing within alluvial banks, the hills rise by easy slopes to the uplands, and nearly every part of the surface is susceptible of tillage. In the southern counties where the shaly rocks of the Lower Barrens, or the shales, fireclays, coals, limestones and thin-bedded sandstones of later formations present themselves to be subjected to atmospheric erosion, the surface is generally smoothly sculptured, but curiously reticulated with crooked, interlocking valleys, and studded with steep, conical hills. In this region much of the land is cultivated with difficulty, and such a thing as a straight highway for a mile or two is unknown.

The following general summary of approximate elevations shows that the uplands as well as the valleys gradually slope from the rim of the basin towards the Allegheny and Ohio rivers:

Potter county, plateaus and summits above ocean,	2300′ to 2600′
McKean county, plateaus and summits above ocean,	2100′ to 2500′
Warren county, plateaus and summits above ocean,	1800′ to 2170′
Crawford county, plateaus and summits above ocean,	1400′ to 1800′
Erie county, plateaus and summits above ocean,	1200′ to 1600′
Elk county, plateaus and summits above ocean,	1800′ to 2160′
Forest county, plateaus and summits above ocean,	1600′ to 1900′
Venango county, plateaus and summits above ocean,	1400′ to 1726′
Mercer county, plateaus and summits above ocean,	1100′ to 1500′
Jefferson county, plateaus and summits above ocean,	1600′ to 1800′
Clarion county, plateaus and summits above ocean,	1500′ to 1775′
Butler county, plateaus and summits above ocean,	1300′ to 1525′
Lawrence county, plateaus and summits above ocean,	1100′ to 1500′
Indiana county, plateaus and summits above ocean,	1500′ to 2000′
Armstrong county, plateaus and summits above ocean,	1200 to 1600′
Beaver county, plateaus and summits above ocean,	1100′ to 1450′
Westmoreland county, plateaus and summits above ocean,	1400′ to 1800′
Allegheny county, plateaus and summits above ocean,	1000′ to 1400′
Washington county, plateaus and summits above ocean,	1100′ to 1500′
Fayette county, plateaus and summits above ocean,	1500′ to 2500′
Greene county, plateaus and summits above ocean,	1200′ to 1550′

An additional illustration of the gradual sloping of the highlands towards the southwest is furnished by the "Big Level" divide, which lies between the waters of the Allegheny and the Clarion, and trends in a southwesterly direction from the State line south of Olean, N. Y., to the Allegheny river near Foxburg, in Clarion county, Pa. This is an unbroken, and in many places a flat-topped ridge, with a remarkably uniform crest. At the State line its summit is about 2400′ above ocean; at Kane, about 2150′; (the P. & E. R. R. crosses it here at 2021′); at Marienville, Forest county, 1775′; at Tylersburg, Clarion county, about 1600′; and at St. Petersburgh, near the Allegheny, about 1400′—showing a fall of 1000′ in about 80 miles.

CHAPTER III.

Summary of Geological Structure.

The geological structure of the Pennsylvania oil regions is said to be very simple. The rocks are all sedimentary; they lie in nearly parallel layers, sloping gently towards the southwest, and—except in the eastern and southern counties—are but slightly warped out of their normal planes. And yet, while these leading features seem to be so easily comprehended, we cannot but feel that much remains to be learned regarding the precise methods by which this apparently simple structure was built up through the agencies of ancient sediment-bearing rivers and sea-assorting currents, which wrought unceasingly for ages to accomplish the task.

In these beds of stratified rock, oil and gas have been obtained at several geological levels; but as neither have been found in this State in older strata than Portage-Chemung, (we join the two, because no line of demarkation can be drawn between them, in the oil region) it will be sufficient for the purposes of this summary sketch, if we confine our attention wholly to this and the overlying groups.

To make our range of observation still narrower, we may say that no oil or gas have been obtained from rocks lying above the Pittsburgh coal bed; and then, taking this coal as the top of the section to be considered, we will have, theoretically, the following sequence of formations in descending order:

Carboniferous	Pittsburgh Coal bed	No. XV.
	Lower Barren Measures	No. XIV.
	Lower Productive Coal Measures . .	No. XIII.
	Conglomerate Series	No. XII.
Sub-Carboniferous . . .	Mauch Chunk Red Shale	No. XI.
	Pocono Sandstones	No. X.
Devonian	Catskill Beds	No. IX.
	Chemung-Portage, upper part of . . .	No. VIII.

[The full scheme of the Carboniferous System is as follows:—

Upper . . .	Waynesburg series,	XVII.
	Washington series,	XVI.
	Monongahela series, (down to Pittsburgh bed,)	XV.
Middle . .	Pittsburgh series, (Barren measures,)	XIV.
	Allegheny series,	XIII.
	Pottsville series, (Great conglomerate,)	XII.
Lower . .	Mauch Chunk series,	XI.
	Pocono series, (Southern coal measures,)—J. P. L.]	

No estimates of thicknesses are given above, because the several formations, (particularly Nos. IX. X. and XI.) vary so greatly in different parts of the region, that any scale with generalized measurements would be misleading. In this place it will suffice to consider the formations, simply in their natural order; the details of structure are given elsewhere.

In the above named formations the following productive oil and gas horizons occur; the oil and gas having always been found in beds of sandstone.

Mahoning Sandstone: Lying at the base of the Lower Barren Measures. (No. XIII.) Oil-bearing on Dunkard Creek, Greene county, and sometimes giving good indications in Fayette and Westmoreland.

Conglomerate Series. (Pottsville, No. XII.) Sometimes produces both oil and gas, in small portions of Washington, Beaver and Lawrence counties.

Berea Grit. (Pocono, No. X?) Oil and gas in Beaver and Lawrence counties.

Gas Sand of Butler. (No. X?) This is quite an important gas horizon, lying about 100′ above the Venango oil group. It has produced gas freely in Butler county and occasionally yields some in Allegheny and Washington.

The quantities of oil and gas furnished by the above horizons, are small as compared with the yield from lower strata; and as the rocks are present in productive form and under sufficient cover, only in the southwestern part of the State, where they have already been proven to be very unreliable, it is not probable that they will contribute very largely to the production of the future.

Venango Oil Group. From 300′ to 400′ in thickness, and lying apparently in the plane where Chemung (No. VIII) merges into Catskill (No. IX.) This is the great oil and gas group of the region. It extends from the southwest corner of Warren county, in a southwesterly direction, to Greene county; and throughout all this country it is the lowest productive oil horizon known.

Large flows of gas have been obtained in the southeasterly part of Venango county from a sandstone lying about 900′ below the Venango group, (probably one of the members of the Warren group.) This gas pool, however, has a restricted range as compared with the whole field, and outside of it, all of the deep wells on the Venango belt have been total failures.

Warren Group. (Chemung, No. VIII.) Thickness, say 600′. An interval of about 500′ separates this group from the Venango. Four or five productive sands are included in the series, some producing oil and gas and some gas alone. So far the production from it has been confined to the eastern part of Warren county and the northern part of Forest. One or more of the sands, however, can be traced rather intermittently, in a southerly and southwesterly direction across Forest county into Clarion and Venango.

McKean Group. (Chemung, No. VIII.) The thickness of this group, counting the drillers' first, second and third sands, (the latter, the "Bradford Third Sand" being of a dark brown color) is about 600′; and it appears to lie stratigraphically, very nearly in the same position as the Warren group,—that is, approximately, 500′ below the place of the Venango group. A direct connection between the two groups cannot, however, be proven as the distinctive features of each appear to be lost in the middle ground between them. But the upper rocks of the McKean have many characteristics in common with the upper rocks of Warren; and it is a significant hint that the "Cooper Sand"—the lowest member of the Warren group—is generally overlaid by a brown sand, somewhat similar in appearance to the "Bradford Third sand," and that this brown sand sometimes produces oil almost as freely as the underlying gray sand. These facts make it appear highly probable that both groups belong to one and the same period of deposition, the variations in composition and structure being due to the different kinds of materials brought into the basin near the places where the respective groups were forming.

In a portion of McKean county the Bradford sand is of great thickness and has been wonderfully prolific both in oil and gas; but nowhere else in the State is it productive. Indeed, it is questionable whether any sand has ever been found in the State, outside of McKean county, that could be positively identified as the Bradford sand.

Elk Group. (No. VIII.) In Elk county, and also in the southern and eastern parts of McKean, several brown sands are found at horizons varying from 100′ to 500′ below the Bradford sand. The Kane oil and gas wells, and a number of other large gas wells and small oil wells in McKean and Elk counties draw their supplies from these sands. The exact details of stratification have not yet been worked out. We only know that certain sands lying in this horizon are productive,' and that they are likely to have their best production in Elk county.

We have now briefly referred to all the principal oil and gas bearing horizons of the Pennsylvania oil fields, to wit:

1. Mahoning Sandstone.
2. Conglomerate Series.
3. Berea Grit.
4. Gas Sand of Butler.
5. Venango Oil Group.
6. Warren Group.
7. McKean Group.
8. Elk Group.

Rated according to production, Nos. 1, 2, 3 and 4, are of secondary importance. Nos. 5, 6 and 7 are the great storehouses that have furnished nearly all of the production of the past, and to them, most probably, must we look for future supplies. No. 8 has made a fair beginning but its future is still uncertain.

The first four groups are classed in the Carboniferous age, the last four in the Devonian. But the exact horizon of the Venango Group is open to question, since some geologists place it in the Chemung formation, and others in Catskill, or even as high as Pocono: It may be interesting, therefore, to note some of the peculiarities of the group.

On the northerly end of the Venango oil belt, at Tidioute, in Warren county, the interval between the base of No. XII and the top member, or First sand of the Venango group is about 450′. In Washington county, on the southerly end of present developments, and about 110 miles from Tidioute, it is over 700′. At Hyner, in Clinton county, about 95 miles southeasterly from Tidioute, the vertical distance between the base of No. XII and the top of Chemung, (No. VIII.) is, according to Mr. Chance, 1816 feet. And in Preston county, West Virginia, about 65 miles southeasterly from Washington, Prof. White finds the same interval to be 1973 feet.

Now, if the Venango group be Chemung, we have only about 450′ of sediments at Tidioute to represent the total deposits made during the Mauch Chunk, Pocono and Catskill periods, while four times that depth of rock-making materials were laid down during the same time in Clinton county and in West Virginia.

This great thickening of the measures towards the southeast indicates that the deepest part of the basin receiving the deposits lay in that direction, and suggests the probabilities of old shore lines along its northwestern margin. May not the Venango Sandstones belong to these, and represent the shallow-water deposits of more than one period?

Some of its structural features seem to favor the hypothesis that the Venango group is a transition series. Its composition appears to be a mixture of Chemung and Catskill sediments. In its normal development it always lies—as far as can be judged from oil well drillings—on good Chemung bottom, and the lowest member seems to have many Chemung characteristics. The middle members take in more of the Catskill element, and the top member carries over it in many places a heavy red bed which seems to belong either to Catskill age or to Pocono.

When the group is traced towards the southeast, its typical sandstones fine down and fade away into masses of red and gray micaceous, sandy shales, the red coming in below the horizon of the oil sands, and sometimes extending above it; but in the opposite direction—towards the northwest—the group disappears in deposits of unimpeachable Chemung.

Still another fact, and a very suggestive one, may be noted here. The great productive oil belt from Warren county to Washington, follows exactly this line where Chemung and Catskill sediments apparently mingle. Northwest of it where the measures are good Chemung, no oil nor gas of practical value have been obtained in the plane of the Venango group; southeast, where a decided Catskill type of sediments prevails, the same is true; and it may be remarked, also, that although the Catskill beds are of great thickness within the State, they have never given any one a paying oil or gas well off of the Venango oil belt.

CHAPTER IV.

Developments During 1886.

The chapters on oil and gas published in the last Annual Report of the Geological Survey were prepared in November, 1885, and consequently the general review of the situation in the field and the statistics of production were only brought up to the first of that month. This report is dated January 1st, 1887, and as a preliminary to the geological facts and details that are to be presented, it will be both interesting and instructive to briefly consider what the results of fourteen months' active developments have been—how they have affected the old districts, what new fields have been opened, what new discoveries made by the drill —for from these actually demonstrated facts which cannot be gainsaid we ought to be able to draw some deductions of value in relation to the question of future supplies in the Oil Regions of Pennsylvania. It may be, also, that these deductions, based upon the logic of practical experience, will be thought worthy of some consideration even by those who profess to believe that the oil supply is practically inexhaustible, and who are ever ready to treat all purely geological opinions upon the subject with supercilious contempt.

Allegany Co., N. Y.

Active operations in this field during the last fourteen months have pretty thoroughly developed it without bringing to notice any new geological features or adding to the daily output of oil, as the following figures prove:

Average daily production for Oct., 1885	6,747 bbls.
" " " " Dec., 1886	5,178 "
" " decrease in 14 months	1,569 "

Meantime, according to the *Petroleum Age* (which publishes monthly a careful list of wells completed, giving location, owners' names and the quantity of oil each well produced on the last day of the month in which it commenced to produce) 405 new wells were drilled (47 of them dry) having an aggregate daily production of 2,191 barrels,* as seen in detail in the table on page 629.

In October, 1885, the number of producing wells in the Allegany district was estimated in the *Age* at 3,980. Since then 358 productive wells have been added, making 4,338 to account for January 1, 1887. Analyzing these figures we find that an *increase* of 9 per cent. in the number of wells has resulted in a *decrease* of 23 per cent. in the average daily production.

Bradford, or McKean District.

The results of thorough exploitation and long-continued depletion are now manifesting themselves in this wonderfully productive and tenacious district as plainly as in Allegany county. With a wide productive area, a thick sandrock of fine grain, which yields its oil slowly, but responds generously to repeated torpedoing, and a large number of wells that can be operated cheaply—it is likely to hold its position as the banner district of the State for several years; but unless deeper drilling should disclose some new oil horizon, its future history can only be a continuation of the story of gradual decline and exhaustion, already partly told by the following statistics:

Average daily production for Oct., 1885,	**30,180**	**bbls.**
" " " " Dec., 1886,	**22,422**	**"**
" " decrease in 14 months,	**7,758**	**"**

Meantime 544 new wells, (43 of them dry) have been drilled, having an aggregate daily production of 3,913 bbls. October, 1885, 13,635 wells producing a daily average of 30,180 bbls. December, 1886, 14,136 wells producing a daily average of 22,422 bbls.

An *increase* of about $3\frac{2}{3}$ per cent. in the number of wells and a *decrease* $25\frac{7}{10}$ per cent. in average daily production.

*** That is, these wells, if they had continued to produce at the same rate they were yielding on the last day of the month in which they were completed, would have been producing an aggregate of 2,191 barrels on the 31st of December, 1886.**

Kane District.

This is a new "black sand" field located in the south-western part of McKean county and extending a little across the line into Elk. Sand was struck in the first well, the Clemenger or Craig & Cappeau No. 1, on the 11th of Nov. 1885; but the well was not "drilled in" until the 11th of December on which date it produced about 95 barrels.

Up to the 1st of Jan. 1887, 372 wells, (22 of them dry) had been drilled in the district, having an aggregate daily production, as reported by the *Age*, of 15,654 bbls.

The productive area is now outlined and the output decreasing.

At its maximum, in June the average pipe line runs were 5,702 barrels per day, from 174 wells ; in December, 3,607 barrels from 350 wells. Total production to Jan. 1st 1887, 1,284,647 bbls.

The oil is here found in a brown sand very similar in appearance to the Bradford oil sand, but evidently not the same stratum since it lies geologically several hundred feet below the Bradford sand horizon. It is the lowest productive oil horizon thus far developed in the State, and as traces of it were found in a number of "wild cat" wells in Elk Co. several years ago, the drill has been actively at work in that section all the past year, seeking for another oil pool. From all that can be learned about these developments, however, nothing better than a ten barrel well has yet been obtained.

Warren and Forest District.

The several sub-divisions of this field have been pretty thoroughly exploited during the last fourteen months, without the discovery of any new pools. The following figures show some of the results :

Kinzua Village, Warren, &c, . . .	**132**	**wells**	**drilled**	**(31**	**dry)**	**prod.**	**1,273**	**bbls**
Clarendon, ...	**246**	"	"	**7**	"	"	**1,336**	"
Tiona, ...	**278**	"	"	**8**	"	"	**1,662**	"
Cooper, ...	**28**	"	"	**7**	"	"	**279**	"
Balltown, ...	**73**	"	"	**11**	"	"	**1,647**	"
Grand Valley, ...	**335**	"	"	**33**	"	"	**3,332**	"
Totals, ...	**1092**	"	"	**97**	"	"	**9,529**	"

Stowell's Petroleum Reporter gives the "Warren & Forest" district a daily average production of 7,180 barrels in October 1885. For December 1886 it gives to the "Warren" district (which appears to include Kane) a daily production of 10,855 barrels. After deducting Kane, (3,607 barrels) we have 7,248 barrels per day to represent the district called Warren & Forest in Oct. 1885, an increase of 68 barrels per day in the sub-divisions mentioned above. The insignificance of this increase seems startling when we consider the fact that 1092 wells have been drilled and 9,529 barrels of new production added to secure it.

Venango, Clarion and Butler.

The results of very active development and a great deal of deep drilling in these old fields, during the period under review, have been the discovery of the Tar Kill and Tipperary pools and the depletion of the Red Valley pool in Venango county; the opening of Reibold pool and several other prolific pockets and spurs in Butler county; and the culmination and decline of operations in the Cogley Run pool of Clarion county—all of them yielding from the Venango Oil Group.

The deep drilling proves that the Speechley gas sand spreads out under a large extent of country, but so far no very promising indications of its being an oil producer have been discovered although several wells have made a considerable show of oil. It seems to show also that if there are other horizons beneath the Venango Oil Group, they are not easily found in this part of the country.

Between Nov. 1st 1885 and Jan. 1st 1887, 1475 new wells were drilled in this district to wit:

Venango, ...	**693 wells**	**(173 of them dry)**	**prod.**	**12,961 bbls.**
Clarion, ...	**385 "**	**60 " " "**	**"**	**6,006 "**
Butler, ...	**397 "**	**94 " " "**	**"**	**10,166 "**
Totals	**1475**	**327 " " "**		**29,133**

But with this large number of new wells and this great addition to the production, the increased output is not nearly as much as might reasonably have been expected. Grand Valley pool in Warren county, Tar Kill and Red

Valley in Venango county, Cogley in Clarion county and Pontius in Butler county—all pools of more than ordinary promise—have reached their maximum output during the months under review and fallen into a fatal decline, which threatens ere long to reduce the production of the district below what it was in October 1885.

Lower Dist. daily average, Oct. 1885, (*Stowells Reporter*,)	**22,728 bbls.**
" " " " Dec. 1886 " "	**26,580 "**
Increase in daily production,	**3,802 "**

This seems to indicate that the drilling of 1475, which had a production of their own, (as estimated on the last day of the month in which they were completed) of 29,133 barrels, increased the previous output of 22,728 barrels by $16\frac{7}{10}$ per cent—but we shall see presently that this increase is probably overstated.

Shannopin District.

This is a new field lying along the dividing line between Allegheny and Beaver Counties, and coming into prominence since Feb. 1886. Its oil is derived from the lower part of the Venango Oil Group which in this locality seems to be "spotted" or unreliable, as shown by the large proportion of dry holes to productive wells

June,	**daily average runs,**	**46**	**wells drilled,**	**(26 dry,)**	**272 bbls**
Oct	**" "**	**97**	**" "**	**42 "**	**4.401 "**
Dec	**" "**	**132**	**" "**	**48 "**	**3.031 "**

The aggregate production of the field up to Jan. 1st 1887, is given at 483,338 barrels.

The district seems already to have arrived at that stage of development where an increase of wells is unable to check a declining production. It may lead out however, into other pools, but if it does we have no good reason to expect that they will be larger or more enduring than this

The new production of the 132 wells drilled was 9,591 barrels.

Washington District.

Sand was struck in the first oil well in this district—the Gantz well—Jan. 1st 1885, but active developments did not commence until after the Gordon well, (which was drilled for gas) found oil in large quantities and in a deeper sand than the Gantz sand. This was in the latter part of August 1885, and inasmuch as the drilling was deep, troublesome and expensive the next wells came in slowly and in February 1886 the first pipe line runs are reported, averaging 497 barrels per day. The principal part of the oil comes from the "Gantz Sand" and "Fifty-foot rock" lying in the horizon of the First sand of the Venango Oil Group. Large wells have been obtained also in the "Gordon Sand" lying near the bottom of the Group, and likewise, in one or two exceptional instances, in the basal rocks of the Carboniferous series above the Oil Group.

The following figures from the *Petroleum Age* give some intimation of what may be expected from that part of the field now under the drill.

Feb. 1886 Average daily runs, 6 wells drilled, ... 497 bbls.
Sept. " " " " 94 " " (20 dry) 13,143 "
Dec " " " " 157 " " (36 dry) 8,841 "

Total runs to Jan. 1, 1887, 2,418,872 bbls. Total new production from 157 wells 32,707 bbls.

Several very deep wells have been drilled in this district, but no oil producing rocks have been found below the Venango Oil Group.

Recapitulation.

	New Wells.	Dry.	New Production.	Increase.	Decrease.
Allegany, N.Y., McKean Group; "black sand",	405	47	2,191	. . .	1,569
Bradford, McKean Group; "black sand,"	544	43	3,913	. .	7,758
Kane, Elk Group "black sand", . .	372	22	15,654	3,607	. . .
Warren & Forest, Warren Group "white sand," . .	1,092	97	9,529	68	. . .
Venango & Butler, Venango Group, "white sand,"	1,475	327	29,133	3,802	. . .
Shannopin, Venango Group, "white sand,"	132	48	9,591	3,031	. . .
Washington, Venango Group, "white sand,"	157	36	32,707	8,841	. . .
Miscellaneous, ...	91	62	198	198	. .
Results of 14 months' operations, ...	4,268	682	102,916	19,547	9,327

These figures show an apparent increase of 10,220 barrels in the average daily production of the whole oil field, since October 1885. But this is considerable larger than the actual increase as shown by the systematic reports of the *Petroleum Age*, page 1528.

Total daily production Dec. 1886,	66,383	barrels.
" " " Oct. 1885,	60,088	"
" " increase,	6,295	"

The discrepancy is due to the use of figures from the *Petroleum Reporter* in estimating the present production of Warren & Forest and Venango & Butler districts. The *Age* says the average daily production of Allegany and Bradford in Dec. 1886 was 27,600 barrels; the *Reporter* 22,710 barrels. Still the *Reporter* gives a total average production for the month about 4,000 barrels in excess of the *Age*, and it is evident that this result could not be arrived at without accrediting too much production to the white sand fields.

A reduction to the *Age's* figures, (and they are undoubtedly nearest the truth) would wipe out all increase in the old districts, and show the gains to be derived entirely from the new—thus,

Kane—new field—production in Dec., 1886,	3,607	bbls.
Shannopin—new field—production in Dec., 1886,	3,031	"
Washington—new field—production in Dec., 1886,	8,841	"
Miscellaneous. Production in Dec., 1886,	198	"
Total daily production of new fields,	15,677	"
Deduct decrease in Allegany and Bradford,	9,327	"
Net increase in all the fields,	6,350	"

Taking this view of the situation, it appears that the drilling of 2,567 new wells, (having an aggregate daily production of 38,662 bbls.) in the old "White Sand" districts between Bradford and Southern Butler, simply neutralized the decline of the old wells and left the field in December, 1886, with about the same average output that it had in October, 1885. A similar result is shown by the figures of aggregate production:

Total production for the year 1886 (see below,)	25,080,460	bbls.
" " " " " 1885 (see oil chart,)	20,900,000	"
Increase,	4,180,460	"

All of which seems to have been furnished by the new pools developed in 1886, to wit:

Kane, total production, 1886,	1,284,647	bbls.
Shannopin, total production, 1886,	483,338	"
Washington, total production, 1886,	2,418,872	"
Aggregate production, 1886,	4,186,857	"

Total production of the Pennsylvania and New York oil fields from November 1, 1885, to January 1, 1887, according to the monthly averages given in *Petroleum Age*, page 1528.*

Nov.,	1885.	Daily average,	61,444	bbls.	Total production,	1 843,320	bbls.
Dec.,	"	" "	59,603	"	" "	1,847,693	"
Jan.,	1886.	" "	57,272	"	" "	1,775,432	"
Feb.,	"	" "	57,840	"	" "	1.619 520	"
Mar.,	"	" "	59 764	"	" "	1 852,684	"
Apr.,	"	" "	63,027	"	" "	1,890,810	"
May,	"	" "	68,198	"	" "	2,114,138	"
June,	"	" "	74,454	"	" "	2,233 620	"
July,	"	" "	73,887	"	" "	2,290,497	"
Aug.,	"	" "	76 657	"	" "	2,376,367	"
Sept.,	"	" "	78,228	"	" "	2,346,840	"
Oct.,	"	" "	77,009	"	" "	2,387,279	"
Nov.,	"	" "	71,180	"	" "	2,135,400	"
Dec.,	"	" "	66,383	"	" "	2 057,873	"
Total production 14 months,						28,771,473	"
Deduct Nov. and Dec., 1885,						3,691,013	"
Total production in 1886,						25,080 460	"

Some interesting hints may be obtained by looking at the results in still another light. If the wells of October, 1885, which were producing at that time an average of 60,088 barrels per day, had maintained a steady output during the next 426 days they would have produced by the 1st of January, 1887, a total of 25,597,488 barrels; and if the new wells drilled had continued to yield as they were yielding on the last day of the month in which they were completed, they would have made an aggregate of 18,522,529 barrels, as follows:—

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* NOTE.—On page 1531 the total production for 1886 (exclusive of Macksburg) foots up 25,435 505 barrels, but no explanation is given to account for its disagreement with the monthly averages.

Prospective estimate of Production of New Wells.

Nov., 1885.	New	prod.,	4,583	bbls.	396	days	to Jan. 1, 1887,	1,814,868 bbls.
Dec.,	"	"	3,886	"	365	"	do	1,418,890 "
Jan., 1886.	"	"	2,983	"	334	"	do	996,322 "
Feb.,	"	"	3,352	"	306	"	do	1,025,712 "
Mar.,	"	"	5.205	"	275	"	do	1,431,875 "
Apr.,	"	"	8,782	"	245	"	do	2,151,590 "
May,	"	"	11,588	"	214	"	do	2,479,832 "
June,	"	"	9,027	"	184	"	do	1,660,968 "
July,	"	"	10,119	"	153	"	do	1,548,207 "
Aug.,	"	"	13,790	"	122	"	do	1,682,880 "
Sept.,	"	"	13 540	"	92	"	do	1,245,680 "
Oct.,	"	"	6,574	"	61	"	do	401,014 "
Nov.,	"	"	5,361	"	31	"	do	166,191 "
Dec.,	"	"	4,126	"	0	"	do	. . . .
Totals, ...			102,916	"				18,022,529 "
Production of the wells during the month of completion, say,								500,000 "
Total, ...								18,522,529 "

Prospective production from old wells, ...	25,597,488 bbls.
Prospective production from new wells, ...	18,522,529 "
Total prospective production, ...	44,120,017 "
Total production realized, ...	28,771,473 "
Shrinkage, ...	15,348,544 "

Equal to 34⅘ per cent. of the prospective and 53.34 per cent. of the actual production.

We have seen above that the new pools of Kane, Shannopin and Washington furnished all the increased production of 1886; from which it would appear that the old districts of Allegany, Bradford, Warren and Forest, and Venango and Butler held their ground during the last fourteen months, having been reinforced by 3607 new wells, (576 of them, or about 16 per cent being dry) which added a new production aggregating 44,766 barrels per day. But it is to be noticed that although these new wells, many of them drilled in rich pools like Grand Valley, Tar Kill, Red Valley, Cogley and Pontius, added largely to the output for a short time, they soon fell off in production, so that the old fields were making a much lower daily average in Dec. 1886 than they were in Oct. 1885—as seen follows :—

Average daily production Dec. 1886, ...	66,8 83	bbls.
Deduct daily production of new fields Dec. 1886, ...	15,677	"
Average daily production of the old fields Dec. 1886, . . .	50,706	"
" " " " " " " Oct. 1885, . . .	60,088	"
Shrinkage in daily production, ...	9,382	"

A decrease in fourteen months of 9,382 barrels per day in the old oil fields, notwithstanding the large number of wells put down, and the assistance of the five or six very promising pools that have come under the drill.

Total production of the Pennsylvania and New York Oil Fields from August 1839 to January 1st 1887.

Total to Jan. 1st 1885, (Oil Chart No. 1, published in 1885), .	248,783 000	bbls.
" production in 1886 (*Petroleum Age*, page 1531), ...	25,435,505	"
Grand total to January 1st 1887, ...	310 218,505	

Divided among the several districts and pools as follows:

Allegany, N. Y., ...	20,483,809	bbls.		
Bradford, Pa., ...	131,713,911	"		
Kane, Pa., ...	1,284,647	"		
Total from "black sand" district, ...			153 482 367	bbls.
Cherry Grove, Warren Co., ...	3,610,539	"		
Cooper, Warren and Forest, ...	2,672,650	"		
Balltown, Forest Co., ...	2,280,860	"		
Total from "white sand" pools of Warren and Forest .			8,564,049	"
Tarkill, Venango Co., ...	559,564	"		
Red Valley, Venango Co., ...	358,391	"		
Cogley, Clarion Co., ...	1,723 294	"		
Pontius, Butler Co., ...	560,780	"		
Thorn Creek and Baldridge, Butler Co.,. .	3,484,096	"		
Total from "white sand" pools of Venango, Clarion and Butler, ...			6,686,125	"
Total from other parts of Warren and Forest, and Venango and Butler, ...			138,583,754	"
Shannopin, Beaver and Allegheny Co.s, .	483,338	"		
Washington, Washington Co., . . .	2,418,872	"		
Total from new southern "white sand" pools, ...			2,902,210	"
Grand total of all fields to Jan. 1, 1887, ...			310,218,505	"

These figures of development and production, however faulty they may be, and in whatever way they are studied, show most unmistakably that the great Pennsylvania oil fields, which have supplied the world for years, are becoming exhausted, and cannot respond to the heavy drafts made upon them many years longer, unless reinforced by new deposits from deeper oil horizons. Probably 55,000 drill holes, scattered all over the country from the Alleghenies to the Lake, have been sunk in Pennsylvania and New York since oil developments commenced in 1859. They have given us a practical knowledge of three great groups of oil bearing sandrocks, each group occupying its own geographical area in which the rocks of the other groups are never productive. They have drawn from the black sands of the Bradford group, in about 12 years, 153,482,367 barrels of oil; and from the Warren and Forest white sand group, in 11 years, and the old Venango Oil Group in 27 years an aggregate of 156,736,138 barrels. These three great oil bearing horizons have been exploited in every direction until the outlines of production seem to be pretty definitely defined. On the ranges of best development they have been thoroughly covered with drill-holes, and now, in glancing over the several fields, we find the production in every one of them declining, and nothing new of importance in sight. No doubt many good pools yet lie undiscovered in these old oil horizons within the boundaries of the State, and possibly some deeper productive strata may be found; but developments so far give very little promise of finding them immediately beneath the old oil belts.

The demands of consumption are now so large that the production of old wells alone, numerous as they are, would come far short of meeting them. Several new pools like those recently discovered are needed each year to keep up the output. The above table shows that the celebrated pools of Cherry Grove, Cooper, Balltown, Tarkill, Red Valley, Cogley, Pontius, Thorn Creek and Baldridge, Shannopin, Washington and Kane have produced during their whole lives, (and some of them are over four years old) only about three-quarters of the quantity of oil actually shipped out of the oil regions in 1886. It is to be noticed also, that the renowned Allegany field, in New York, now over five years old and perforated by about 4200 drill holes, has produced up to the present time barely sufficient oil to satisfy the current demands of 1886 for ten months.

TABLE *showing the number of new wells drilled and the estimated amount of new production in each month from October, 1885, to January, 1887. Compiled from the monthly reports of the "Petroleum Age."*

	1885. Nov.		1885. Dec.		1886. Jan.		1886. Feb.		1886. Mar.		1886. Apr.		1886. May.		1886. June.	
	Wells completed.	New Production.	Wells.	Production.	Wells.	Production.	Wells.	Production.	Wells.	Production.	Wells.	Production.	Wells.	Production.	Wells.	Production.
Allegany,	*4 47	263	4 51	287	5 39	238	8 31	202	7 28	162	3 31	198	5 29	178	3 28	188
Bradford,	3 65	512	3 60	459	3 41	333	3 47	372	3 48	389	4 43	382	6 39	335	1 35	262
Kane,			1	96	4 3	220	3 11	398	1 16	1,650	2 45	2 865	6 49	3,828	3 49	2 168
Kinzua, &c.,	4 14	165	3 12	258	3 6	78	1 8	93	5 8	56	3 7	43	1 8	79	2 9	42
Clarendon,	1 22	128	34	197	1 18	102	21	109	18	108	3 20	116	25	138	19	105
Tiona,	2 35	225	1 30	185	2 29	166	20	106	1 22	147	26	164	25	172	30	183
Cooper,	7	156	3	29	1 2	23	3 1	6	1 3	25	1 3	30			1	5
Balltown,	1 8	225	6	215	1 7	180	1 7	158	7	175	3 5	106	5	185	2 4	155
Grand Valley,									4 12	140	5 17	247	4 37	587	8 42	482
Venango,	18 37	521	14 39	414	17 24	403	5 35	657	12 36	1 016	15 36	620	15 32	510	8 48	2,350
Clarion,	6 78	2,015	9 57	1 562	2 30	527	2 28	478	6 24	409	7 17	176	1 17	147	1 17	207
Butler & Armstrong,	16 17	348	8 14	173	4 12	232	9 11	362	6 14	504	6 28	955	6 18	446	6 20	786

TABLE *showing number of new wells drilled, &c.—Continued.*

	1885. Nov.		1885. Dec.		1886. Jan.		1886. Feb.		1886. Mar.		1886. Apr.		1886. May.		1886. June.	
	Wells completed.	New Production.	Wells.	Production.	Wells.	Production.	Wells.	Production.	Wells.	Production.	Wells.	Production.	Wells.	Production.	Wells.	Production.
Shannopin	.	. . .	.	. . .	. . .	. .	.	.	2		6	. .	6		12	
	.	. .	.	. .	. .	. . .			3	46	6	245	3	123	8	265
Washington		. . .							2			.	3		6	
		. .		.	2	410	4	365	7	378	6	2,640	7	4,860	6	1,879
Miscellaneous	3		3		2		5						4		4	
	5	25	8	11	7	71	6	51		.						
Totals	388	4,583	355	3,886	265	2,983	265	3,252	296	5,205	353	8,782	351	11,588	372	9,027
Dry wells	53		45		45		35		50		58	.	57		56	.

TABLE *showing number of new wells drilled, &c.—Continued.*

	1886. July.		1886. Aug.		1886. Sept.		1886. Oct.		1886. Nov.		1886. Dec.			
	Wells.	Production.	Wells.	Production.	Wells.	Production.	Wells.	Production.	Wells.	Production.	Wells.	Production.	Total wells.	Total new production in barrels.
Allegany,	1		1		1		5		5				47	
	24	148	16	96	8	54	15	98	4	41	7	43	358	2,191
Bradford,	2		5		1		2		3		4		43	
	27	229	23	145	21	160	17	99	17	126	13	110	501	3,913
Kane,	1						1				1		22	
	61	1,935	39	1,020	29	646	29	565	12	200	6	68	350	15,654
Kinzua, &c.,	4		2						1		2		31	
	2	130	3	15	4	30	5	81	7	172	8	81	101	1,273
Clarendon,					1				1				7	
	14	72	13	69	13	73	9	47	7	38	6	34	239	1,336
Tiona,	1						1						8	
	18	114	12	64	8	50	7	36	2	14	6	36	270	1,662
Cooper,							1						7	
									1	5			21	279
Balltown,					2						1		11	
	5	90	3	78	2	40	2	25			1	15	62	1,647
Grand Valley,	6		1		1		1		2		1		33	
	54	562	43	491	31	331	33	300	15	124	13	118	302	3,332
Venango,	11		15		11		12		8		17		173	
	55	3,366	63	1,855	29	405	36	425	31	288	19	133	520	12,961
Clarion,	2		4		3		9		5		3		60	
	13	126	10	73	11	125	10	96	9	43	4	22	325	6,006
Butler & Armstrong,	7		3		7		6		5		5		94	
	28	862	33	1,299	30	1,059	25	786	28	1 378	27	981	308	10,166

TABLE *showing number of new wells drilled, &c.—Continued.*

	1886. July.		1886. Aug.		1886. Sept.		1886. Oct.		1886. Nov.		1886. Dec			
	Wells.	Production.	Wells.	Production.	Wells.	Production.	Wells.	Production.	Wells.	Production.	Wells.	Production.	Total wells.	Total new production in barrels.
Shannopin,	5		4				7		1		5		48	
	5	320	5	1 850	12	2 853	13	1,575	18	1.719	11	595	84	9 591
Washington,	2		5		2		5		6		5		36	
	8	2,165	18	6,720	18	7,710	14	2,485	19	1,215	14	1,880	121	32,707
Miscellaneous,	4		2		7		12		8		8		62	
			2	15	1	4	2	6	1	5	2	10	29	198
Totals,	358	10,119	328	13,790	253	13,540	279	6,574	216	5 361	189	4,126	4 268	102 916
Dry Wells,	46		42		36		62		45		52		682	

* Upper figures, dry holes; lower figures productive wells.

Review of the Gas Pools.

A great many wells have been drilled for natural gas in the western portion of the State during the last fourteen months, but as far as known, no new sources of supply have been brought to light. The gas pressure in Allegany and Bradford has gradually weakened. Potter county has added several more wells to her list of failures, and the Wilcox gas pool now stands as the most northeasterly one of importance in the State. In the latter quite a number of new wells have been sunk to increase the supply to meet the requirements of the new line recently laid to Buffalo, N. Y. One of the peculiarities of this district is that there are two gas bearing sandrocks separated by about 100′ of shale. Two wells half a mile apart may produce gas from the upper rock and none from the lower, while an intermediate one produces none from the upper and large quantities from the lower. These sands lie below the Bradford Sand, (which here, sometimes, produces a little oil) and probably belong to the same general horizon as the gas sands at Kane and in Elk county; but the well records of this region have been so carelessly kept that it is impossible to make precise identifications. A very large area of possible gas territory remains to be explored in this region.

In the Sheffield gas field nothing new has transpired. The pool is large, well stored, and shows its ability to furnish many wells and maintain a steady output.

The Speechley gas sand in southeasterly Venango county is now known to have an extensive range. It has been traced from Tionesta in Forest county to Black's Station, on the A. V. R. R. in Rockland township, Venango county —a distance of about 24 miles. Some productive wells have been obtained at the north within a few miles of Tionesta, but at Blacks Station it is barren as far as developed.

The original Speechley pool and its immediate surroundings have been the scene of a great deal of activity during the last year. A large number of wells have been drilled and an enormous amount of gas allowed to waste; with the result, as admitted by those who are in a position to know, of a decided decrease of pressure in the pool.

In the Tarkill oil pool, (about six miles from the Speechley well,) a number of wells were drilled down to the Speechley sand, and gas obtained in such quantity and under such pressure that it could be conveyed directly from the wells into the cylinders of the engines at the drilling and pumping wells and used in place of steam. For several months nearly all the engines in that locality were run in this manner. But latterly they have been compelled to fall back on steam, as the direct method of using gas is much more wasteful than its use in generating steam.

Some of the wells on this range have found water in the Speechley sand, almost to the exclusion of gas and others have sprayed considerable oil—in some cases two or three barrels per day. This oil show has confirmed a number of operators in the belief that this sand is also an oil rock, and persistent efforts are now being made to find the oil producing portions of it.

Speechley and Tarkill are within four or five miles of the old Gas City oil developments described in report L. pages 166 and 177, where engines were run by gas as early as 1870. But this gas came from the Venango Oil Group, which lies about 900 feet above the Speechley gas sand.

The Butler gas field has been quite widely developed during the period under review, and some parts of it promise to be of great importance. This gas comes from the Venango Oil Group and the gas sand above it.

The Tarentum gas field has evidently passed its prime. Excessive drilling and salt water in the rock have brought it to an early decline. It is now an open secret that some of the industries established near Tarentum on account of its gas deposits, are now being supplied from the Murraysville field—the mains laid for the purpose of conveying gas from Tarentum to Pittsburgh, being used to carry gas to Tarentum.

The Murraysville, Grapeville, Washington and Beaver fields,—all drawing their gas from the Venango Oil Group —(with the exception of a few wells in Washington county which get some gas also from the Carboniferous sandstones) have been drilled extensively and have responded so freely that the supply is not only ample for all the requirements of Pittsburgh and its surroundings, but sufficient also to be piped from Grapeville to Johnstown on the east, from Washington to Wheeling, &c., on the southwest and from Beaver to Rochester, Beaver Falls and Youngstown on the north. The drafts for all these purposes are enormous, but the fields are large, and no doubt others will be found when the central ones weaken, so that an extension of lines will insure a supply for years to come.

CHAPTER V.

Stratigraphical Review of the Venango Oil Group and overlying Rocks.

The Ohio Sharon-Olean Conglomerate, the lowest member of No. XII, and the basal rock of the Carboniferous series lies several hundred feet beneath river level at Pittsburgh, but, rising towards the north and northeast at an average rate of about twenty feet to the mile, comes up to daylight and characteristically fashions the topography of the country along a belt of considerable width bordering a line from the northwest corner of Mercer county to the northeast corner of McKean county. Northerly from this line the great pebble-sand is found only on the higher ridges, having been cut up into detached masses by surface drainage. The last traces of it in that direction consist of a chain of widely scattered, isolated outliers resting in huge blocks upon the highest summits of the country—proofs that the stratum once extended still farther to the north, and silent witnesses of the stupendous results of atmospheric erosion.

Four of these outliers are found in the State of New York and they all lie within four miles of the State line. The most easterly one occupies an area of about 200 acres near the center of Alma township in Allegany county, the base of the mass being, (by barometer) 2410′ above tide and its highest point 2485′.

The second lies near the center of Genesee township, Allegany county ; a small cluster of detached blocks, some of them 30′ high, perched upon a smoothly weathered summit about 800′ above little Genesee Creek and 2350′ above ocean.

The third holds the celebrated Olean and Flat Iron rock cities. Base of the rock 2340′ above ocean, top 2400. Quite a large area of Conglomerate remains upon this summit, from which all the newer rocks have been removed.

The fourth consists only of a few blocks, all slightly moved from their normal position, lying on the apex of the ridge which divides Red House run from Irish brook, in the southwest part of Red House (formerly Salamanca) township, Cattaraugus county—Elevation of base of Conglomerate 2270′ above ocean. This, as far as known is the only remaining outlier in the State of New York between Tunangwant creek and the Allegheny river.

The next outpost, going southwesterly is the Quaker Hill or "Singular rocks" exposure near the southwest corner of Elk township Warren county (See I⁴ page 186.) Elevation of base 1996′ above ocean. In this neighborhood a coal bed has been mined for years which lies near the base of the Conglomerate and is the only workable representative of the Sharon coal known in Warren, Eastern Crawford or Venango counties.

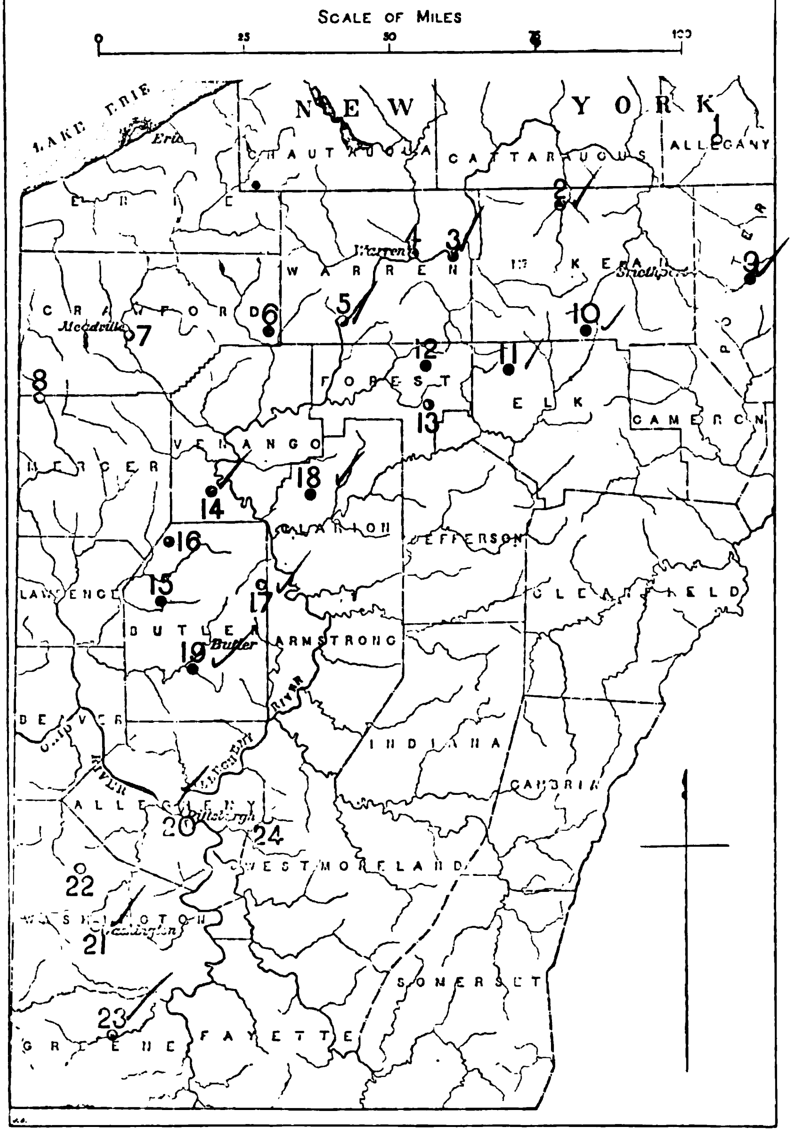
In that portion of Warren county north of Brokenstraw creek and the Allegheny river, very little Conglomerate remains ; but a few small outliers are found in Sugar Grove and Freehold townships, farther north even than Quaker Hill. Pikes rocks in the southwest corner of Sugar Grove are very interesting remnants lying at an elevation of 1940′ above ocean (See I⁴ page 239).

West and southwest of Pikes rocks the country has been entirely denuded of Conglomerate and its scattered outcrops are confined to the easterly side of East Branch and Oil creek as far down as the southeastern corner of Steuben township, Crawford county ; thence it follows the highlands on the southerly side of Muddy creek to the center of Richmond township, where two or three small outliers remain at an altitude of about 1600′ above ocean.

The next exposure is about ten miles towards the southwest,—the College hill quarries at Meadville—elevation of base 1505′ above ocean. (See I⁴ page 36.)

About ten miles further towards the southwest and in East Fallowfield township, a large body of Conglomerate remains, carrying above it as it dips towards the south,

Map of part of
Pennsylvania and New York
showing position of
Columnar Sections



several small coal beds, some iron ore, belonging to the Sharon coal series, and a considerable thickness of more recent rocks. Near the northerly line of the township the elevation of the base of the Conglomerate is 1290′. See I' page 43.)

On the highland west of Little Crooked creek and in the easterly part of South Shenango township, the most westerly outlier in Crawford county is found at an elevation of about 1280′.

Another remnant lies in the northwestern part of Mercer county, on the ridge between Shenango river and the Pymatuning, its northerly outcrop on the State line about 5 miles southwest of Jamestown having an altitude of 1290′ above ocean.

Having now followed the northerly outcrop of the Olean conglomerate across the State from New York to Ohio, we will next examine the structure of the rocks lying immediately below its base—limiting our study for the present to a vertical range of about 800′, which carries the section down to the base of the Venango Oil Group.

Section No. 1.—Allegany Co. N. Y.

The section in this locality is not very definitely made out, but may be generalized for our purpose as follows:

1.	**Olean conglomerate.**	
2.	**Gray sandstones and sandy shale. Pocono type,**	**175′**
3.	**Greenish-gray sandstones and red and gray shale. Catskill type,**	**225′ to 400′**
4.	**Massive flat pebble conglomerate. Catskill type,**	**25′ to 425′**
5.	**A repetition of No. 3. Catskill type,**	**125′ to 550′**
6.	**Shales and flaggy sandstones. Chemung type,**	**250′ to 800′**

In designating the different divisions on these sections, it must not be understood that the rocks belong unquestionably to the groups indicated. It is to be remembered that the divisions between Pocono, Catskill and Chemung are purely arbitrary throughout all the country under examination, for there seems to be no *positive data*, either lithological or palæontological, to indicate exactly where the dividing lines should be drawn. Red rocks are evidently no sure guide, for an abundance of red is found in one locality or another in all these groups. All that can be done at present is to judge, after a careful examination of the general facies of the whole section, about where the typical rocks of each group have their best development, and draw the lines accordingly. The Pocono formation is characterized by a preponderance of very thin-bedded, grayish sandstones, which show a book-leaved or foliated structure on weathered surfaces. The Catskill, by heavy red bands interstratified with greenish-gray, fine-grained, micaceous sandstones. The Chemung, by dark argillaceous slates and shales with thin plates of flaggy, fine-grained, dark-gray sandstones and frequent fossil beds. But these characteristics admit of many modifications, and in many localities the several types are so interwoven that only a provisional grouping of the strata can be attempted.

Section No. 2.—Bradford, McKean Co., Pa.

1.	**Olean conglomerate.**	
2.	**Sandy shale,**	**50'**
3.	**Sub-olean conglomerate; flat pebble,**	**30' to 80'**
4.	**Sandstones and shales. Pocono type,**	**170' to 250'**
5.	**Greenish-gray ss. and red and gray shales. Catskill type,**	**320' to 570'**
6.	**Slates, thin ss. and fossils. Chemung type,**	**230' to 800'**

Here, it will be noticed, the rocks of Pocono type are thicker than in Allegany Co., N. Y., and a conglomeritic member—the *Sub-olean*—comes in at the top. This rock, which passes under the name of Shenango sandstone in the western part of the State, underlies the Olean conglomerate at a distance of about 50 feet all along its outcrop from New York to Ohio. Its eastern representative is a massive flat-pebble conglomerate; its western, a yellowish, iron-spotted, medium-grained sandstone. Traced southerly from eastern Warren and western McKean, where it has its best development as a conglomerate, the interval between it and the Olean thickens very materially—increasing from 50 feet at Warren to 200 feet or more in the southerly part of Forest and Elk, where both rocks, still massive conglomerates, may frequently be seen in one and the same exposure. But following the Shenango sandstone portion of it towards the south—say from Crawford county to south Venango—a similar thickening of the measures above it is not so plainly apparent. South of this we are obliged to depend upon the drill for our sections, as the Shenango sandstone runs below water level. In that region neither Olean nor Shenango are conglomeritic; the intervening shales are sandy. and it seems quite probable that the driller's "mountain sand," often given as one stratum 300 feet or more in thickness, ends, not at the base of the Olean, but at the base of the Shenango. This, however, will be referred to more fully in the succeeding sections.

Section No. 3.—Great Bend, Warren Co.

1.	**Olean conglomerate.**			
2.	**Sandy shale,**			**25'**
3.	**Sub-olean conglomerate,**			**30' to 55'**
4.	**Gray sandstones and shales.**		**Pocono type,**	**220' to 275'**
5.	**Red slate,**	**3'**	**Catskill type?**	**88' to 363'**
	Greenish-gray ss,	**17'**		
	Olive shales,	**43'**		
	Red sandy shale,	**2'**		
	Sandy shale,	**9'**		
	Greenish-gray ss.,	**14'**		
6.	**Shales and sandstones,**	**92'**	**Chemung type,**	**437' to 800'**
	SS. massive, 1st oil sand?	**18'**		
	Shales,	**53'**		
	Sandstone,	**18'**		
	Shale,	**11'**		
	Sandstone,	**10'**		
	Shale,	**34'**		
	Sandstone,	**8'**		
	Shales and thin sandstones,	**193'**		

In this locality the Olean and Sub-olean are both well developed. No. 4 is less sandy than the Pocono farther east, and the line between it and No. 5 can only be drawn arbitrarily, for there is no positive lithological change to mark a transition from one group to the other. The sandstones of No. 5 are of a greenish-gray cast, resembling somewhat the Catskill sandstones of Potter county, and there are two little red bands in this 88' interval; still it cannot be postively affirmed that the measures belong to Catskill age. The rocks of No. 6 have a Chemung aspect and contain Chemung fossils, but the upper 18' sandstone seems very probably to represent the first oil sand of Venango, and this is found in sections 12 and 13 in intimate association with typical Catskill red beds.

Section No. 4.—Warren, Warren Co.

1.	Olean Conglomerate.			
2.	Sandy Shale,			40'
3.	Sub-olean,			30' to 70'
4.	Shales & sandstones,	315'	Pocono type,	398' to 468'
5.	Sandstone,	19'		
6.	Sandy shale,	64'		
7.	SS. Venango 1st oil sand?	19'	Chemung type,	180' to 648
8.	Sandy shale,	120'		
9.	SS. and 2' red shale,	31'		
10.	Dark red sandy shale,	10'		
11.	Bluish-gray shales, slates & flags; Chemung,			152' to 800'

Section No. 5.—Tidioute, Warren Co.

1.	Olean Conglomerate.			
2.	Sandy shale,			40
3.	Sub-olean,			30' to 70'
4.	Sandy shale,	175'	Pocono type, Crawford shales,	410' to 480'
5.	SS. thin-bedded,	35'		
6.	Shales,	200'		
7.	First oil sand of Venango,	25	Venango Oil Group,	285' to 765
8.	Slate & shale,	80		
9.	Second oil sand, upper,	25		
10.	Shales gray & brown,	30		
11.	Second oil sand, lower,	15		
12.	Slate & shells,	75		
13.	Third oil sand,	35		
14.	Slaty shale, dark,			35' to 800'

Section No. 6.—Church Run, Crawford Co.

1,	Olean Conglomerate.			
2.	Sandy Shale,			50
3.	Sub Olean, Shenango sandstone,			25' to 75'
4.	Sandy shale & slate,	160'	Crawford shale,	435' to 510'
5.	SS. yellowish, flaggy,	30'		
6.	Slate & shale, red near bottom,	245'		
7.	First Oil sand of Venango,	40'	Venango Oil group,	305' to 815'
8.	Slate & shells, no 2d sand,	185'		
9.	Stray sand,	17'		
10.	Slate,	28'		
11.	Third oil sand,	40'		

It would be a troublesome undertaking to draw the lines between Pocono, Catskill and Chemung in the last three sections, if each is actually present as a distinct and separate group. At the top we have the Olean conglomerate, an indisputable horizon, at the bottom the measures are undoubtedly Chemung. The Pocono has changed very materially in composition and thickness (as compared with section No. 1) if it represents the Crawford shales; and the Catskill, if the Venango Oil Group be a part of it, has lost nearly all of its characteristic red and green and made very large acquisitions of white pebbly sands. We seem to be passing over a range where the Upper Chemung is separated from the Lower Pocono, not by beds of typical Catskill rocks, but by a transition group formed by the commingling of materials which were common stock for all three of the periods while the requisite conditions for deposition lasted.

For a more extended discussion of this subject see I' Chapter XIII.

Section No. 7.—Meadville, Crawford Co.

1. Olean Conglomerate.			
2. Sandy shale. Shenango shale,			35
3. Sub-olean, Shenango sandstone,			25′ to 60′
4. Shales, bluish,	25	Crawford shales,	308′ to 368
5. Limestone,	1		
6. Shales & flaggy sandstones,	95		
7. Limestone,	2		
8. Shales & flaggy sandstones,	185		
9. Slate & shells in Citizens' oil well, no sands,			432′ to 800′

The division between Crawford shales and Chemung cannot be fixed with any degree of certainty in this Section, neither can anything resembling Catskill be found in it. The measures above the well mouth have the usual characteristics of the Crawford shales. The rocks exposed at the well look like Chemung and contain large numbers of Chemung fossils. The drillers state that no sandstone over four feet in thickness was found while drilling to a depth of 1,104 ft. It would seem from this that the Venango Oil Group is not present in this locality, as the drill found nothing but Chemung slates and shales—such as always underlie the horizon of the group along its northwesterly range.

Section No. 8.—Jamestown, Mercer Co.

1. Olean Conglomerate, Sharon Conglomerate.	
2. Flaggy Sandstone & shale. Shenango shales,	40
3. Sub-olean, Shenango sandstone,	15′ to 55′

4.	Shales & flaggy sandstone,	25'	Crawford Shale,	435' to 490
5.	Limestone,	1'		
6.	Shales & flaggy sandstone,	105'		
7.	Limestone,	2'		
8.	Flaggy sandstone,	12'		
9.	Slate & shells, in Gibson well,	90'		
10.	SS. fine-grained, blue,	20'		
11.	Slate, bluish,	65'		
12.	SS. estimated,	25'		
13.	Slate, bluish,	90'		
14.	SS coarse, pebbly, (show of oil),	18	Chemung,	310' to 800'
15.	Slate & shale, soft,	92		
16.	Red rock & hard shale,	100		
17.	Hard sandy slate,	50		
18.	Slate,	50		

There is nothing in this section to give the slightest indication of the presence of Catskill rocks. The Crawford shales seem to lie immediately upon, or to merge into Chemung. Dr Gibson's well continued on down through similar deposits to those found at Meadville, to the depth of 1065 feet from the surface; that is 465' feet below the bottom of this section.

Reviewing these sections we find nothing in Nos. 1 and 2 to represent the Venango Oil group in anything like its normal condition; in Nos. 3 and 4 some traces of it appear; in Nos. 5 and 6 it is well developed and produces oil; in Nos. 7 and 8 its location is open to question. Its position, as compared with the Olean conglomerate is shown by the following figures:

3.	Great Bend	—distance from O. C. to 1st Oil sand (?),	455'
4.	Warren	" " " " 1st Oil sand (?),	468'
5.	Tidioute	" " " " 1st Oil sand,	480'
6.	Church Run	" " " " " " "	510'
7.	Meadville	" " " " " " "	?
8.	Jamestown	" " " " 1st Oil sand (?),	490'

For further comparison we will now take a line of sections at localities 20 to 25 miles southerly from those already given.

Section No. 9.—Coudersport, Potter Co.

1.	Olean conglomerate.'			
2.	SS. thin-bedded, gray and shale. Pocono type,			325'
3.	Red and gray shale and greenish SS	175'	Catskill type,	425' to 750'
4.	ditto, (reported in well)	250'		
5.	Slate and shells. Chemung type,			50' to 800'

GEOLOGICAL SURVEY OF PENNSYLVANIA – J. P. LESLEY, State Geologist.

SECTIONS SHOWING THE GEOLOGICAL STRUCTURE FROM

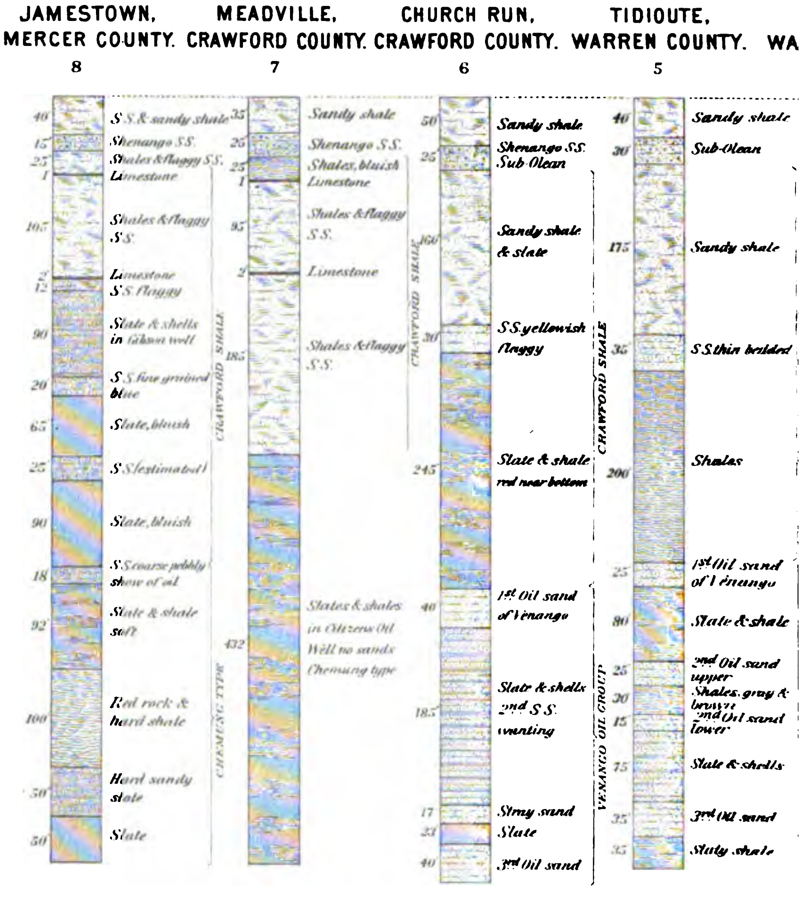
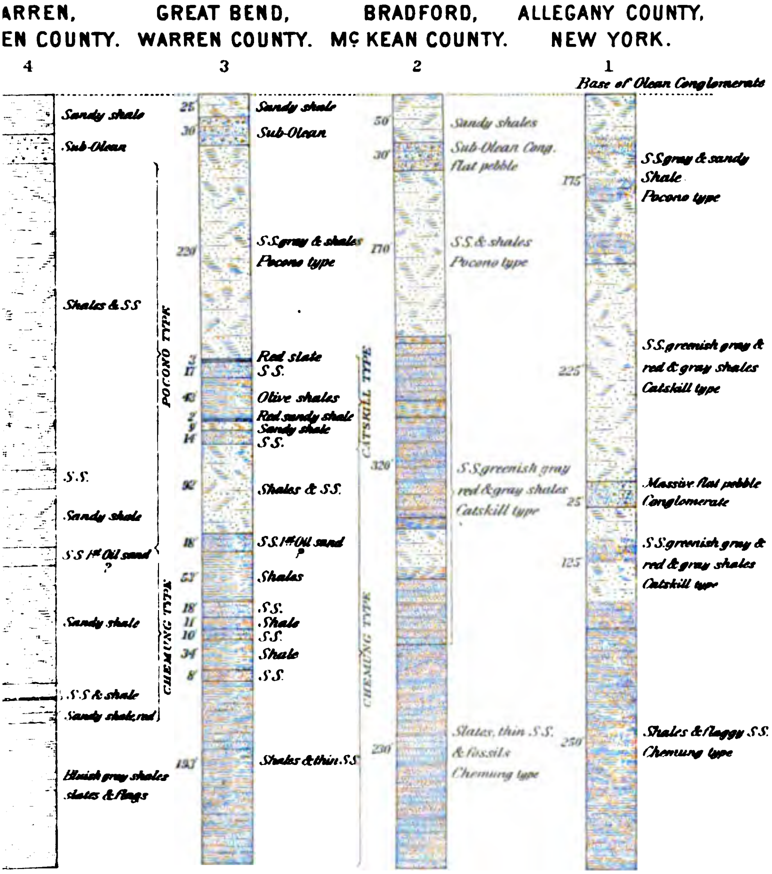


Plate 1.

LLEGANY COUNTY, NEW YORK TO MERCER COUNTY, PENNA.



Scale 200 Feet to 1 Inch.

The sand-pumpings down to bottom of well at 1800 feet below the base of this section are evidently Chemung—sandy slates and thin brownish sandstones. Compared with Section No. 1, a very decided thickening of both Pocono and Catskill is apparent.

Section No. 10.—Sergeant township, McKean Co.

1.	Olean conglomerate.	
2.	Sandy shale,	80'
3.	SS. Sub-olean,	60' to 140'
4.	Sandstones and sandy shale. Pocono type,	365' to 505'
5.	Red rocks and sandy slate. Catskill type,	305' to 810

Here the Pocono and Catskill are much thicker than at Bradford. It is not claimed that the exact division between the formations can be given, but if the red rocks represent Catskill it is plainly evident that this group thickens going southeastward—as does also the Pocono above it.

Section No. 11.—Highland township, Elk Co.

1.	Olean conglomerate.	
2.	Sandy shale,	80'
3.	SS. Sub-olean,	30' to 110'
4.	Sandstones and sandy shale. Pocono type,	410' to 520'
5.	Red rocks and sandy slate. Catskill type,	400' to 920'

This section is about 7 miles southwest from No. 10, eighteen miles northeast from No. 13, (the three being almost exactly in line) and 11 miles almost due east from No. 12. Comparing these four it will be observed that the red rocks lie deeper and have a greater thickness in No. 11 than in any of the others. The important question is, do the upper red beds in all of these sections belong to one and the same geological horizon, or do the northwestern reds change color when traced towards the centre of the basin, and others come in at lower levels as shown on Plate VI. Chap. XI, report I'. It is to be regretted that the well records of this region have been so imperfectly kept that the question cannot yet be answered satisfactorily—but it is reasonable to infer that the red rocks were deposited here in the same way as they were a few miles farther southwest; and if so, we see how unreliable any attempted classification of the rocks must be that is based mainly upon color.

Section No. 12.—Howe township, Forest Co.

1.	Olean conglomerate.			
2.	Sandy shale and sandstone,			170′
3.	SS. Sub-olean,			45′ to 215′
4.	Sandy shale and slate. Pocono type, Crawford shales,			241′ to 456′
5.	SS.,	20′	Horizon of Venango Oil group,	225′ to 681′
6.	Slate,	30′		
7.	Red rock,	125′		
8.	SS.,	10′		
9.	Slate,	35′		
10.	SS. flaggy,	5′		
11.	Slate and shells. Chemung type,			119′ to 800′

Section No. 13.—Marienville, Forest Co.

1.	Olean conglomerate.			
2.	Sandy shale and sandstone,			196′
3.	SS. conglomeritic. Sub-olean (?)			55′ to 251′
4.	Slate and shells, some red at bottom. Crawford shales,			302′ to 553′
5.	SS.,	25′	Horizon of Venango Oil group,	325′ to 878′
6.	Slate,	33′		
7.	Red rock,	85′		
8.	SS. variable,	52′		
9.	Slate,	42′		
10.	SS.,	12′		
11.	Red rock,	23′		
12.	SS.,	17′		
13.	Slate,	30′		
14.	SS. gray,	6′		

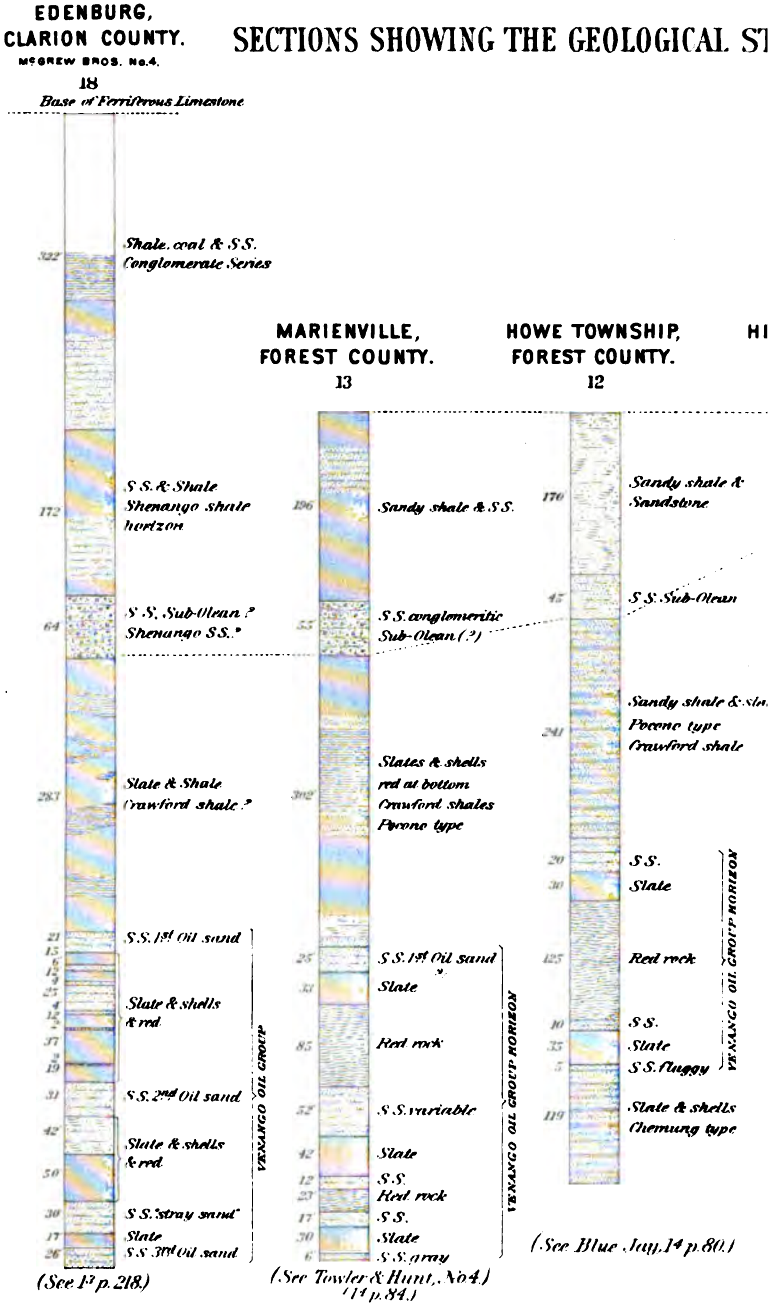
This section shows a very fair representation of the Venango Oil group, (compare with No. 18, Edenburg) but although 5 or 6 wells have been drilled here, nothing but gas has been obtained from it.

So far our sections have been given at localities where the Olean conglomerate lies plainly in view and there can be no mistake in using its base as a datum plane for the measurements below it; but proceeding towards the southwest this rock gradually sinks below drainage level, and as its base can seldom be correctly located in ordinary well records, it will be more satisfactory to take the Ferriferous limestone for the upper limit of the sections that are to follow.

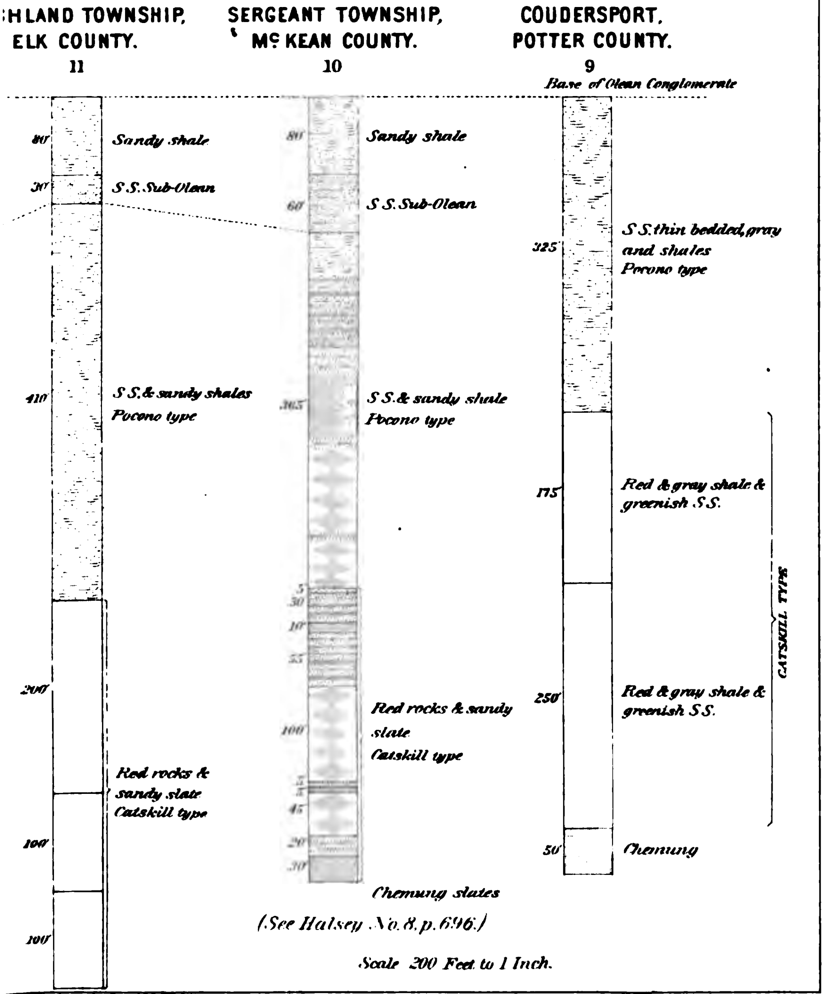
The Ferriferous limestone is the driller's key-rock in Butler county, and although it thins out in a southerly direction its horizon is plainly discernible in well records at Pittsburgh and Washington. In Butler county, according to Mr. Chance, (V. p. 225) its average distance above the

GEOLOGICAL SURVEY OF PENNSYLVANIA – J.P. LESLEY, State Geologist.

SECTIONS SHOWING THE GEOLOGICAL S



RUCTURE FROM POTTER COUNTY TO CLARION COUNTY.


:HLAND TOWNSHIP, ELK COUNTY.
11
SERGEANT TOWNSHIP, McKEAN COUNTY.
10
COUDERSPORT, POTTER COUNTY.
9
Base of Olean Conglomerate
80'
Sandy shale
30'
S.S. Sub-Olean
410'
S.S. & sandy shales Pocono type
200'
100'
100'
Red rocks & sandy slate Catskill type
80'
Sandy shale
60'
S.S. Sub-Olean
365'
S.S. & sandy shale Pocono type
5
30
10'
55
100'
5
5
45
20'
30'
Red rocks & sandy slate Catskill type
Chemung slates
325'
S.S. thin bedded, gray and shales Pocono type
175'
Red & gray shale & greenish S.S.
250'
Red & gray shale & greenish S.S.
CATSKILL TYPE
50'
Chemung

(See Halsey No. 8, p. 696.)

Scale 200 Feet to 1 Inch.

base of the Sharon-Olean conglomerate, is about 325′, which agrees substantially with Prof. White's measurements in Mercer and Beaver counties. The generalized section of the strata occupying this interval is as follows:

1.	**Ferriferous limestone.**	
2.	**Clarion and Brookville shales and coals,**	60′
3.	**Homewood sandstone,**	30′ to 90′
4.	**Mercer Group, coal, shale and limestone,**	30′ to 120′
5.	**Connoquenessing Group, SS. shale and coal,**	155′ to 275′
6.	**Sharon Group—coal and shales,**	10′ to 285′
7.	**Sharon-Ohio-Olean conglomerate,**	40′ to 325′

The Homewood sandstone is the top member, and the Sharon conglomerate the bottom member of the Beaver River or Conglomerate series, the basal rocks of the Carboniferous formation. Like all other groups of sandstones, this series is very variable in the details of its structure. But while its individual members may locally thicken or thin, or split up into several beds, the changes in one horizon are generally compensated by changes in others, so that the average thickness of the whole group is not materially altered.

In the Bullion Run district the Venango Oil group, with its overlying red rock is nominally developed, and the Ferriferous limestone outcrops upon the hills. Here we may get a typical section of all the measures from the base of the limestone to the base of the Venango Oil group.

Section No. 14.—Bullion Run, Venango Co.

1.	**Ferriferous limestone.**			
2.	**Interval to base of Sharon conglomerate, as above,**			325′
3.	**Sandy shale. Shenango shale (?)**			60′ to 385′
4.	**"Mountain sand" (Well, I^{3} p. 129) Shenango SS. (?)**			100′ to 485′
5.	**Slates and shales,**	190′	**Crawford shales,**	385′ to 870′
6.	**SS. hard,**	20′		
7.	**Slate,**	75′		
8.	**Red rock,**	100′		
9.	**SS. 1st Oil Sand,**	85′	**Venango Oil group,**	331′ to 1201′
10.	**Slate and shells,**	20′		
11.	**Red rock,**	45′		
12.	**SS. 2d Oil Sand,**	40′		
13.	**Slate,**	45′		
14.	**Red rock,**	10′		
15.	**SS. Stray Sand,**	20′		
16.	**Slate,**	35′		
17.	**SS. 3d Oil Sand,**	31′		

About 20 miles southwest from Bullion, a similar structure is seen in the John Smith well, southerly part of Brady township, Butler county. (I⁵ p. 418.)

Section No. 15.—Brady township, Butler Co.

1.	Ferriferous limestone.			
2.	Slate and shale,	27′		323′
3.	SS. Homewood,	18′		
4.	Black slate, &c.,	110′		
5.	SS. Connoquenessing,	65′		
6.	Slate,	3′		
7.	SS. Sharon,	100′		
8.	Slate and shells.		Shenango shales (?)	72′ to 395′
9.	SS. gray,	50	"Mountain sand"—Shenango SS. (?),	90′ to 485
10.	Slate and shells,	10′		
11.	SS.,	30′		
12.	Slate,	180′	Crawford shales,	400′ to 885′
13.	SS.,	26′		
14.	Slate and shells,	119′		
15.	Red rock,	60′		
16.	Slate and shells,	15′		
17.	SS. 1st Oil sand,	60′	Venango Oil group,	320′ to 1205′
18.	Slate,	85′		
19.	SS. (20′ slate in center) 2d Oil Sand,	65′		
20.	Slate,	55′		
21.	SS. Stray sand,	5′		
22.	Slate,	31′		
23.	SS. (poor) 3d Oil sand,	19′		

Comparing the above with Bullion, (No. 14) a remarkable uniformity of structure is observed; and putting these with Church Run and Tidioute, (Nos. 6 and 5) the Shenango shales and Shenango sandstone appear to be growing thicker as they are traced towards the south. If the Mountain Sand in Butler be really the southerly extension of the Shenango sandstone, then it will be seen as we carry our sections southward that the Shenango shales lie in the horizon of the Mountain or Siliceous limestone, for in the vicinity of Pittsburgh this limestone comes in above the Mountain sand.

A little northwest of a line between the last two sections a number of wells have recently been drilled for gas in Mercer and Slippery Rock townships. Their records were not kept in detail, but they give a general idea of the structure there.

SECTIONS SHOWING THE GEOLOGICAL STRUCTURE

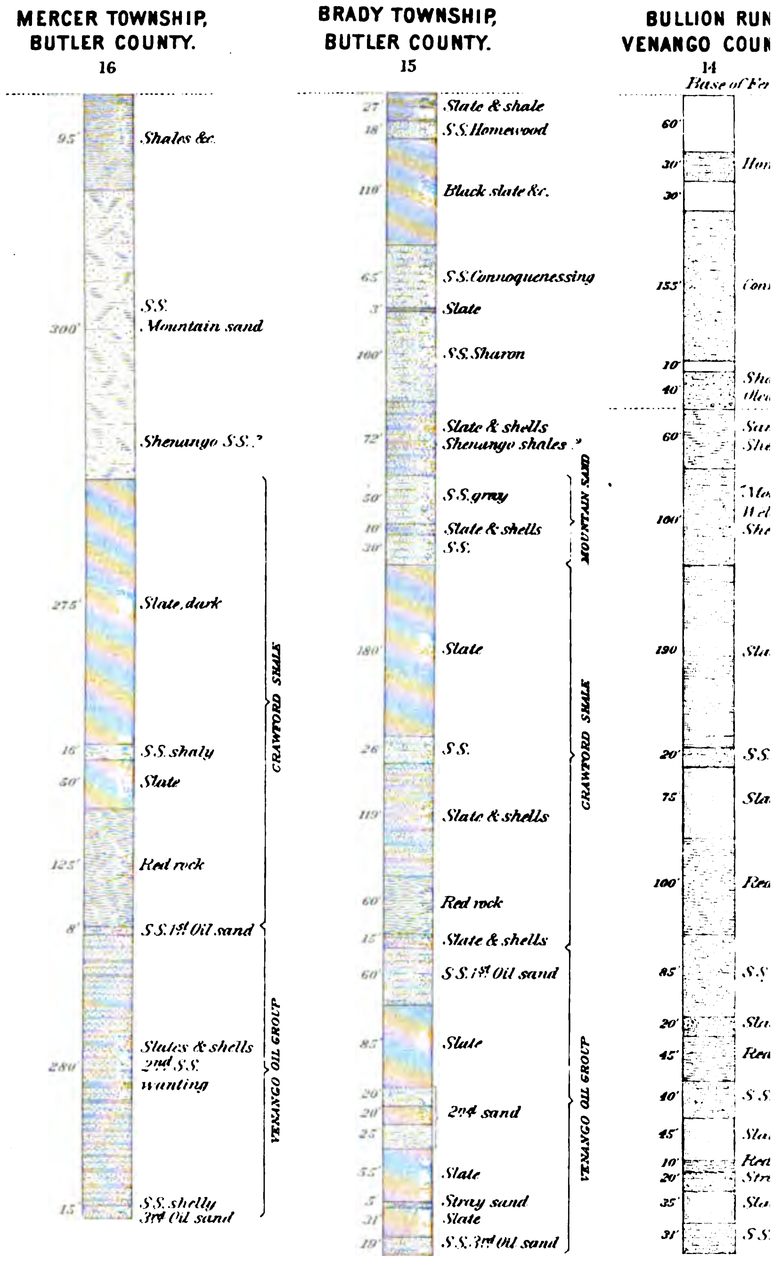
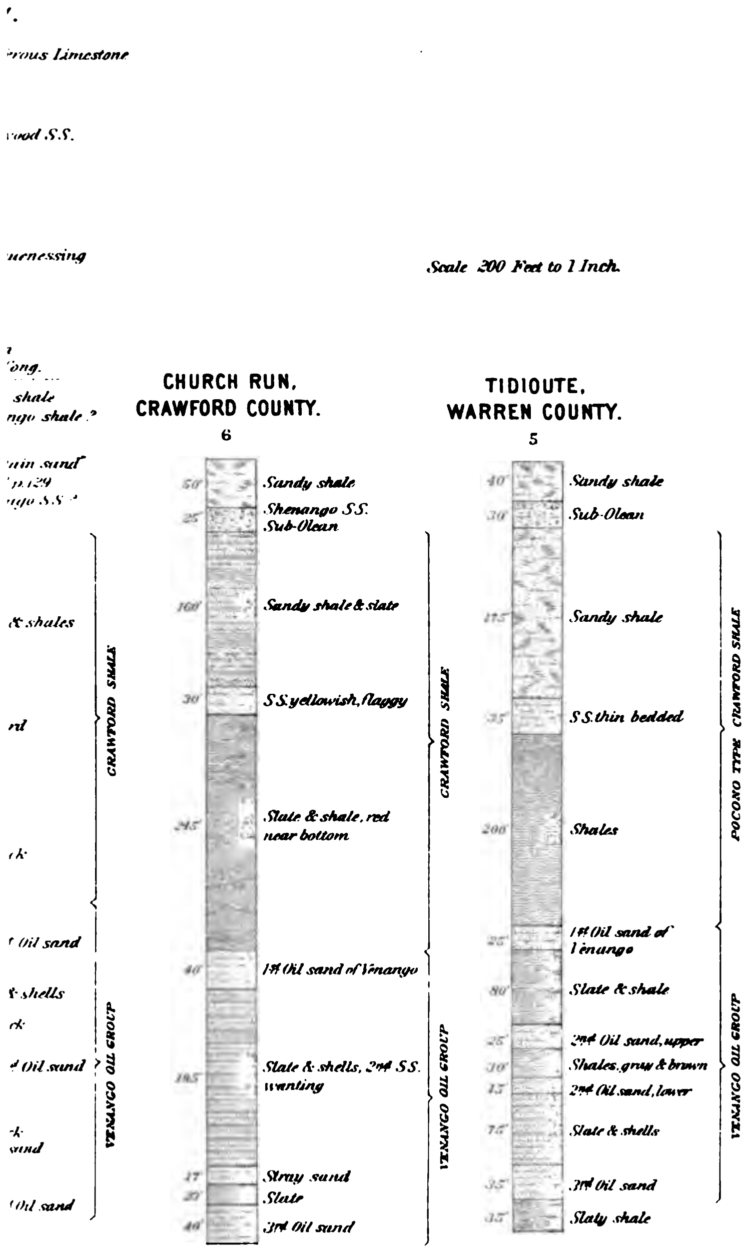


Plate 3.

·ROM WARREN COUNTY TO BUTLER COUNTY.



Section No. 16.—Mercer township, Butler Co.

1.	**Ferriferous limestone.**			
2.	**Shales &c.,**	**95′**	**To base of Shenango. SS. (?),**	**395′**
3.	**SS. "Mountain sand,"**	**300′**		
4.	**Slate, dark,**	**275′**	**Crawford shales,**	**466′ to 861′**
5.	**SS. Shelly,**	**16′**		
6.	**Slate,**	**50′**		
7.	**Red Rock**	**125′**		
8.	**SS. 1st Oil sand,**	**8′**	**Venango Oil group,**	**303′ to 1164′**
9.	**Slate & shells, 2d ss. wanting,**	**280′**		
10.	**SS. Shelly. 3d Oil sand,**	**15′**		

Here it is evident that the Mountain sand, given in all the records in round numbers, and probably without actual measurement, includes all the sand beds between the shales above the Conglomerate series and the Crawford shales below the Shenango sandstone—in which case the Shenango shales and sandstone would appear to measure about the same here (say 75′±) as they do along their outcrops: or it may be possible that all of the Mountain Sand belongs to the Conglomerate series, which has increased somewhat in thickness at the expense of the measures below. Prof. White reports the Shenango sandstone as very thin, (from 3′ to 10′, only) in several places in Mercer County. It may be absent altogether in this part of Butler.

Section No. 17.—Petrolia, Butler Co.

1.	**Ferriferous limestone.**			
2.	**Dark slate and coal,**			**28′**
3.	**SS. Homewood,**	**66′**	**Conglomerate series,**	**359′ to 387′**
4.	**Slate, shells, thin sands & coal,**	**145′**		
5.	**Mountain sand**	**148′**		
6.	**Slate & shells Shenango shales(?)**			**100′ to 487′**
7.	**SS. Shenango SS (?)**			**85′ to 572′**
8.	**Slate & shells. Crawford shales (?)**			**314′ to 916′**
9.	**SS. . . 17′ Slate, . 3′ SS. 54 "100 ft." 1st Oil sand,**	**74′**	**Venango Oil group,**	**334′ to 1250′**
10.	**Red rock, sandy,**	**13′**		
11.	**Slate & shells,**	**36′**		
12.	**SS.**	**6′**		
13.	**Slate; red 27′ bluish 29′,**	**56′**		
14.	**SS,**	**10′**		
15.	**Slate,**	**12′**		
16.	**SS. white,**	**25′**		
17.	**Slate,**	**7′**		
18.	**SS. pebbly,**	**15′**		
19.	**Slate,**	**58′**		
20.	**SS. 3d Oil sand,**	**22′**		

Comparing the above with Sections Nos. 15 and 16, there seems to be two ways of interpreting the structure. The 85′ sandstone, (No. 7) must be the Shenango sandstone enlarged, as are also the shales above it—or it is a new sandstone coming in at this horizon.

A section at Edenburg, Clarion county, to supply the connecting link between the McKean, Warren and Forest sections, where the Sub-olean is traced, and these western sections where the Shenango sandstone is traced, will throw some light upon this subject.

Section No. 18.—Edenburg, Clarion Co.

1.	**Ferriferous limestone.**			
2.	**Shale, coal & sandstone, to base of Conglomerate series,**			**322′**
3.	**SS. & shale Shenango shale horizon (?)**			**172′ to 494′**
4.	**SS. Sub-olean—Shenango sandstone horizon (?)**			**64′ to 558′**
5.	**Slate & shale, Crawford shale, horizon,**			**283′ to 841′**
6.	**SS. 1st Oil sand,**	**21′**	**Venango Oil group,**	**349′ to 1190′**
7.	**Slates, shells & red rock,**	**138′**		
8.	**SS. 2d Oil sand,**	**31′**		
9.	**Slate, shells & red rock,**	**92′**		
10.	**SS. Stray sand,**	**30′**		
11.	**Slate,**	**17′**		
12.	**SS. 3d Oil sand,**	**20′**		

Here we find the 64′ sandstone, (No. 4) lying in the horizon of the Sub-olean as traced from its northeastern outcrops, and also in the horizon of the Shenango sandstone, as traced from its northwestern outcrops—which ought to be pretty good evidence that it belongs to Sub-olean—Shenango age.

In this connection compare Sects. 5, 12, 13, 18, 17, 15 & 16.

Section No. 19.—Thorn Creek, Butler Co.*

1.	**Ferriferous limestone.**			
2.	**Shales and SS.**	**194′**	**To base Shenango SS. (?)**	**414′**
3.	**Mountain sand,**	**220′**		
4.	**Sandy shale,**	**150′**	**Crawford shale horizon (?)**	**535′ to 949′**
5.	**SS.**	**40′**		
6.	**Slate & shells**	**205′**		
7.	**SS. "Gas sand",**	**45′**		
8.	**Slate,**	**95′**		

***Possibly there should be some red rocks in this section; but the record makes no mention of them.**

9.	SS. "100 ft."—1st Oil sand,			97′	Venango Oil group,	361′ to 1310′
10.	Slate & shells,			73′		
11.	SS. "30 ft",	25′	2d Oil sand.	70′		
12.	Slate,	20′				
13.	SS. "Blue Monday",	25′				
14.	Slate,			35′		
15.	SS "Boulder" Stray sand,			15′		
16.	Slate			25′		
17.	SS "3d & 4th sands"—3d Oil sand,			46′		

This section is made from the driller's record of Fisher Oil Company's well No. 18, Wallace farm, Penn township, Butler county. It shows a grand development of the Venango Oil group—the order and arrangement of the sandstones being exactly the same as in some places in the Oil Creek country, fifty miles away. The first oil sand of Venango is here called the "Hundred-foot rock" on account of its great thickness. At Petrolia, and in that neighborhood, where it was not so thick and enclosed a layer of slate, the two sands belonging to its horizon were known to drillers under the names of "Second sand" and "Fifty-foot rock." The "Gantz sand" and "Fifty-foot" of Washington county correspond to these and are nothing more nor less than the Venango first sand, which frequently splits into two members. The "Pittsburgh salt-water sand" and the "Murraysville Gas sand" both belong to the same horizon, as we shall see further on.

In Sutton well No. 4, near Petrolia, (see I' p. 194) a sand shell containing quite a quantity of gas was found about 145′ above the true first oil sand. This at Karns City was called the "1000 ft. shell," and thickening into a pronounced sand rock at St. Joe, became the "First sand" of that region. Toward Butler it proved so prolific in gas that it was named the "Gas rock," which name it bears in the Thorn Creek well record, where it comes only 95′ above the First oil sand. This sand is found from 80′ to 90′ above the "Gantz" sand in Washington county—above the "Salt water sand" at Pittsburgh—above the "Gas sand" at Murraysville—and is a strong corroborative proof that the underlying sands all belong to the horizon of the First oil sand of Venango. In the Washington field this "Gas sand" seems to be shelly and barren ; in South Pittsburgh it is massive and frequently contains much salt water; at Homewood it furnished tremendous outbursts of gas for a short time; and at Murraysville, right over the great anticlinal reservoir of gas, it is so charged with salt water that all the wells have to be cased below it.

While there is no ambiguity about the lower part of this section, the upper portion is not so easily read. Lying at or near the base of the Conglomerate series in Washington county, and at Pittsburgh, we find thick layers of Sub-carboniferous limestone, one part of which closely resembles dark sandy slate, the other a white sandstone. If present in Butler county, this limestone has been drilled through and classed as slate and sandstone, so that in the absence of specimens we are unable to definitely fix its horizon in the section. In the well record copied, the distance from the base of the Ferriferous limestone to the base of the Mountain sand is 414′, and in well No. 19, same farm, it is 440′. Probably these measurements were not carefully taken, as they were not considered important. The figures, however, are so large that it is reasonably certain that the Mountain sand does not end at the base of the Sharon conglomerate. Could we examine the sand-pumpings we should probably find the representative of the Siliceous limestone of Pittsburgh, somewhere near its base. But whatever may be the thickness or the constitution of the Mountain sand it does not seem materially to affect the interval between the Ferriferous limestone and the First oil sand which measures very nearly the same in this section as it does in the one following.

Section No. 20.—Pittsburgh, Allegheny Co.

1.	**Ferriferous limestone.**			
2.	**Slate &c,**	**55′**	**Conglomerate series,**	**262′**
3.	**SS. massive. Homewood,**	**45′**		
4.	**Slate SS. & coal,**	**73′**		
5.	**SS. massive. Connoquenessing,**	**42′**		
6.	**Sandy shale, trace of coal,**	**33′**		
7.	**SS and slate.**	**7′**		
8.	**Sandy slate & coal,**	**7′**		
9.	**Shaly limestone 8′, slaty 15: dark,**	**23′**	**Mountain limestone,**	**79′ to 341′**
10.	**Siliceous " cream color,**	**56′**		
11.	**Slate & shells, dark. Sheuango shales (?)**			**44′ to 385**

12.	SS. massive.		Shenango SS (?)	140' to 525'
13.	Sandy slate,	10'	Crawford shales (?)	436' to 961'
14.	SS. white, shelly,	20'		
15.	Slate & shells, dark,	115'		
16.	SS. slaty in center,	70'		
17.	Slate,	120'		
18.	SS. shelly, fossils, "Gas rock" of Butler,	25'		
19.	Slate,	76'		
20.	SS. massive. 1st Oil sand,	95'	Venango Oil group,	516' to 1477
21.	Sandy slate,	25'		
22.	Slate shells & sand	29'		
23.	SS.	45'		
24.	Sandy slate,	12'		
25.	Red rock,	7'		
26.	Slate & shells,	56'		
27.	SS. gas,	17'		
28.	Slate,	21'		
29.	Red rock, (end of Well No. 2),	8'		
30.	Slate (from Well No. 1),	27'		
31.	SS.	8'		
32.	Slate, shells & red,	22'		
33.	SS.	10'		
34.	Slate shells & red,	15'		
35.	SS.	7'		
36.	Slate,	32'		
37.	Sandy shells & red,	8'		
38.	Slate & shells,	17'		
39.	SS.	7'		
40.	Slate & shells,	39'		
41.	SS.	9'		

This section is made from Messrs. Jones & Laughlins' Well No. 2 located at the American Iron & Steel Works, South Side, Pittsburgh. The record was very carefully kept by Mr. F. T. Gretton, Chemist, who daily preserved and tested the sand-pumpings. Specimens from well No. 1 were also kept, but not so systematically. Complete suits of specimens from both these wells have very kindly been presented to me, and I also have a similar set furnished through the courtesy of Mr. T. J. Vandergrift, from Parkinson well in the eastern part of Mount Pleasant township, Washington county. These, together with specimens from Economy well No. 2, Beaver Falls, (I' p. 401) make it possible to compare the actual sand-pumpings, and study the structure in a very satisfactory manner.

In the Pittsburgh and Parkinson wells, the Ferriferous limestone can be plainly detected—although very thin—in association with a mass of dark shales; at Washington, also, its presence is indicated, and thus we get a reliable horizon to work from.

The Homewood sandstone is well represented in the Pittsburgh section by No. 13, a massive, coarse-grained, pebble-streaked sandstone. The Connoquenessing is not so massive, it takes in some slate near the center, and probably includes some of the sandy layers above No. 5. No. 7 contains a little sand of the same quality as No. 5 and possibly may belong to that horizon. No sand-pumpings like the usual drillings from the Sharon conglomerate were found in Well No. 2, nor in Well No. 1.

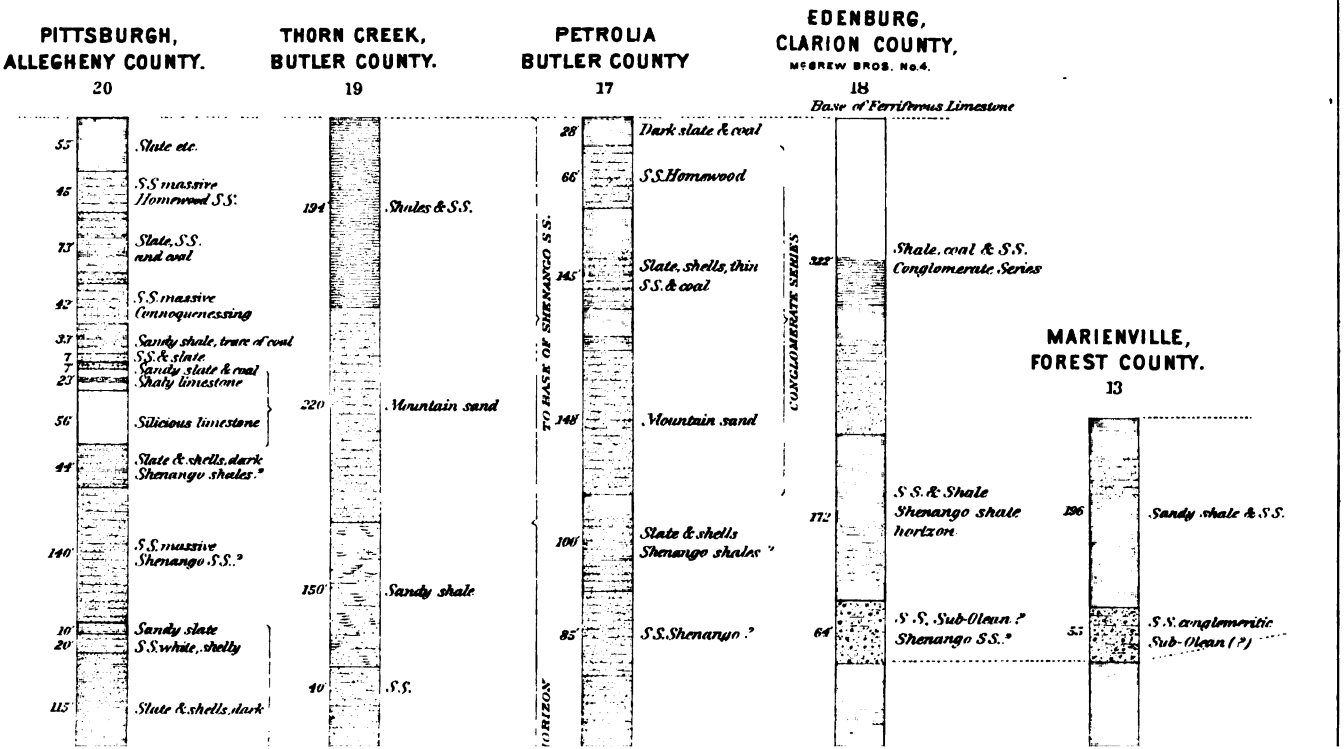
In Economy Well No. 2, Beaver Falls, the distance from top of Homewood sandstone to bottom of Sharon conglomerate is 300 ft. and a test of the specimens preserved, reveals the fact that 15 feet of sandy limestone, very similar in appearance to the Mountain limestone in some localities, lies 40 feet below the Sharon conglomerate. The specimens were not taken as frequently as they should have been, and it is quite probable that the limestone is thicker than represented and lies closer to the Sharon. At any rate, there seems to be good reasons for believing that the *Mountain limestone* is present here and that *its normal position is beneath the Sharon conglomerate.*

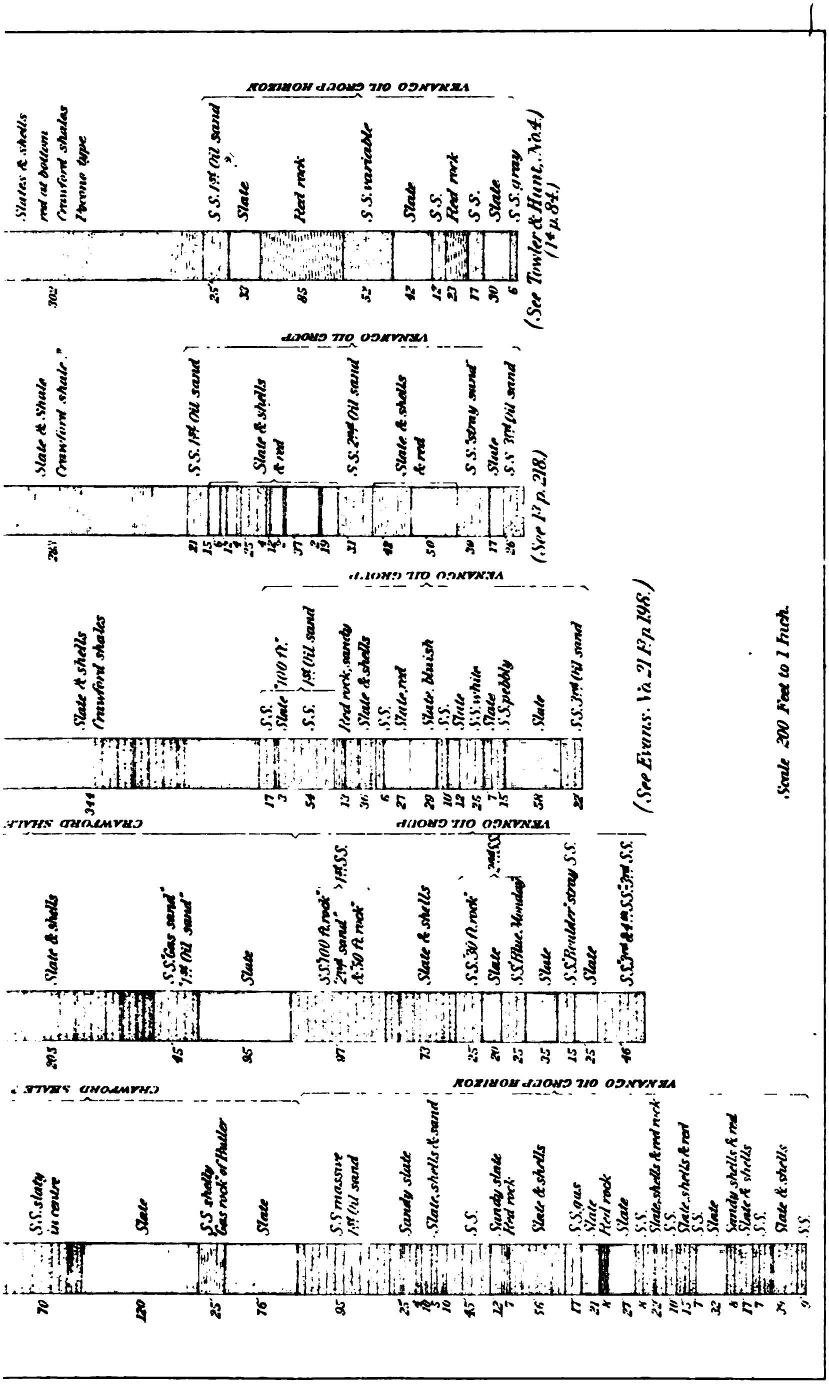
Turning now to the Pittsburgh section, we find a distance of only 207 feet between top of Homewood sandstone and top of Mountain limestone—an interval scarcely large enough to hold the Homewood and Connoquenessing sandstones and their accompanying shales under ordinary development, and one which appears to show nothing but the representatives of these two groups. *These facts seem to indicate that the Sharon conglomerate is wanting in this locality* and consequently the Connoquenessing group is let down upon the Mountain limestone.

Taking this view of the situation, No. 12 seems to lie in the horizon of the Shenango sandstone and No. 16 in the horizon of the Berea grit. No. 18 is unquestionably the "Gas sand" of Butler county and No. 20 the "Hundred-

Plate 4.

SECTIONS SHOWING THE GEOLOGICAL STRUCTURE FROM FOREST COUNTY TO PITTSBURGH.


PITTSBURGH, ALLEGHENY COUNTY.
20
55' Slate etc.
45' S.S massive Homewood S.S.
73' Slate, S.S. and coal
42' S.S. massive Connoquenessing
37' Sandy shale, trace of coal
7 S.S. & slate
7 Sandy slate & coal
23' Shaly limestone
56' Silicious limestone
44' Slate & shells, dark Shenango shales.?
140' S.S. massive Shenango S.S.?
10' Sandy slate
20' S.S. white, shelly
115' Slate & shells, dark
THORN CREEK, BUTLER COUNTY.
19
194' Shales & S.S.
220' Mountain sand
150' Sandy shale
40' S.S.
PETROLIA BUTLER COUNTY
17
TO BASE OF SHENANGO S.S.
HORIZON
28' Dark slate & coal
66' S.S. Homewood
145' Slate, shells, thin S.S. & coal
148' Mountain sand
100' Slate & shells Shenango shales?
85' S.S. Shenango ?
CONGLOMERATE SERIES
EDENBURG, CLARION COUNTY,
McGREW BROS. No. 4.
18
Base of Ferriferous Limestone
322' Shale, coal & S.S. Conglomerate Series
172' S.S. & Shale Shenango shale horizon
64' S.S. Sub-Olean ? Shenango S.S.?
MARIENVILLE, FOREST COUNTY.
13
196' Sandy shale & S.S.
55' S.S. conglomeritic Sub-Olean (?)



Scale 200 Feet to 1 Inch.

foot rock"—that remarkably persistent *First sand* of the Venango Oil group.

The thickness of the strata that should here be assigned to the Oil group may be a subject of question. I am inclined to include in the group all the sandy layers down to the plane where the drill entered continuous slate beds, like those universally found beneath the base of the group along its trend of best development from Tidioute to Thorn creek. Everywhere—so far as my observation goes—wherever the Third or bottom sand of the Oil group is largely developed, it lies immediately upon thick beds of slates, through which the drill sinks hundreds of feet without encountering anything deserving to be called a sandstone.

It seems reasonable then to suppose that these slates are the common floor of the group—that some great physical change took place at the commencement of the Oil-sand period which made it possible for these sands to be deposited over a geographical area where nothing but very fine still-water sediments had been able to find a lodgment in previous ages. We may suppose that the old sea-bottom, when brought into position to serve as a floor for the Oil group, was a sloping, undulating plain, stretching off towards the center of the basin, and while thick sand beds, composed only of water-worn sand-grains, sifted and sorted from a large volume of heterogeneous matter, were being laid down by active currents along the upper slopes, a number of thinner sand beds, of finer texture and interstratified with the shales and clays, which originally formed a large part of the wave-worked materials, would be deposited cotemporaneously in more quiet waters along the lower slopes. In this manner the fully developed *Third sand* along the main belt, might be represented towards the center of the basin by several thin layers of sandstone interbedded with slates and shales; and as a large percentage of the materials wrought upon would naturally yield these finer sediments, the deposits would accumulate more rapidly, where such a structure was possible, than where only coarse sands could be strewn; and the vertical thickness of the group would consequently be greater.

Section No. 21.--Washington, Washington Co.

1.	Ferriferous limestone.						
2.	Shale,						5'
3.	SS.					87'	to 92'
4.	Coal,					1½'	to 93½'
5.	SS.,					81½'	to 175'
6.	Shales, slates, coal and thin sandstones,					95'	to 270'
7.	Limestone, dark	27'			Mountain limestone,	85'	to 355
8.	" light,	58					
9.	SS.,			120'	Mountain sand,	152'	to 507
10.	Slaty. shale,			2'			
11.	SS. (End of Prof. Linton's record),			30'			
12.	Not described, Crawford Shale horizon,					473'	to 980'
13.	SS.,	20'	"Gantz sand"	40'	1st Oil sand,	90'	to 1070
	Slate,	4'					
	SS.,	16'					
14.	Slate,			15'			
15.	SS. "Fifty-foot rock"			35'			
16.	Slate and shells (From Gordon well record),					107'	to 1177
17.	SS.,					36'	to 1213'
18.	Slate,					38'	to 1251'
19.	SS. "Gordon sand" say,					16'	to 1267

The upper part of this section is made from Prof. Linton's record of Thayer well No. 1, Farley farm, Washington. The Ferriferous limestone was not noticed in the sand-pumpings, but it probably belongs in the 19' shaly interval, from 1196' to 1215'. In section No. 20, it is 262' above the Mountain limestone, in section No. 22, 240', and as placed here, it is 270'.

The middle of the section is given by the drillers in blank, merely showing a distance of 473' to the Gantz sand. In this interval, however, we may place the "Gas sand" of Butler, for it is shown in the Weirich farm record 87' above the Gantz sand, and 20' thick. (See records in Chap. VII.)

Below the Gantz and Fifty-foot, the figures are from Gordon well No. 1—as the Thayer well was not sunk through these lower measures. Having no single well record which shows all the leading features truly we are forced to give this combination section. The Mountain limestone is carefully located, and the celebrated Gantz, Fifty-foot and Gordon sands are in their proper places for comparison with other sections.

It will be seen that the *Gordon sand* is not the lowest member of the Oil group, since its bottom is only 287′ below the top of the *Gantz*, or *First oil sand.* There are undoubtedly other thin sands below it, but as several wells have explored the underlying strata without improvement, they are probably barren of oil. I have not been able to obtain the details of any of these deeper drillings. Compared with No. 19 (Thorn Creek) the Gordon sand seems to represent "Blue Monday."

Section No. 22.—Mount Pleasant township, Washington Co.

1. Ferriferous limestone.			
2. Sandy slate, shale, dark and coal,			111′
3. SS. gray,	24′	Connoquenessing type,	119′ to 230′
4. Slate,	22′		
5. SS. gray,	16′		
6. Slate and shells,	25′		
7. SS.,	32′		
8. Slate, very dark,			10′ to 240′
9. Slaty limestone dark,	13′	Mountain limestone,	42′ to 282′
10. Siliceous " cream-white,	29′		
11. SS. slate and shells,			27′ to 309′
12. SS. white, massive,	106′	Mountain sand,	139′ to 448′
13. Slate and sandy slate,	22′		
13. SS. white, fine, hard,	11′		
15. Slate,	27′	Crawford Shale horizon,	505′ to 953
16. SS.,	7′		
17. Slate,	53′		
18. SS. flaggy,	25′		
19. Slate,	160′		
20. SS. flaggy,	10′		
21. Slate,	85′		
22. SS. gray "Gas sand,"	13′		
23. Slate and shells,	125′		
24. SS. white.	12′	1st Oil sand,	42′ to 995′
" slaty at top,	30′		
25. Slate,	79′	(2d Sand wanting),	183′ to 1178,
26. Fossil band,	4′		
27. Slate,	100′		
28. SS. pebbly, gas. not through?			7′ to 1185′

It is interesting to note how remarkably the characteristic structural features of the Venango-Butler oil belt are imitated in Washington county.

At Grand Valley, Church Run, Raymilton, Western

Butler and all along the northwesterly edge of the Oil group, no massive Second sand is found. So here on the westerly border of the Washington oil field the same structure prevails. Compare with Sections Nos. 6 and 16, and see report I. p. 24 &c.

Section No. 23.—Waynesburg, Greene Co.

1.	Ferriferous limestone.				
2.	Slate, dark,				75'
3.	SS., massive. Homewood, SS. (?),				65' to 140'
4.	Shelly slate,				85' to 175'
5.	Red rock,				20' to 195'
6.	Dark slaty limestone,	55'		Mountain limestone,	165' to 360'
7.	White limestone,	110'			
8.	SS. white, Mountain sand,				230' to 590'
9.	Slate,	115'		Crawford Shale horizon,	415' to 1005'
10.	SS. dark,	20'			
11.	Shelly slate,	160'			
12.	SS. gray. "Gas sand,"	40'			
13.	Slate,	80'			
14.	SS. "Gantz"	10'	1st Oil sand, 82'		
15.	Shells,	25'		Venango Oil Gr. horizon,	390' to 1395
16.	SS. "Fifty-foot,"	47'			
17.	Slate & shells, 28'. Red slate, 30,		58'		
18	SS. red, 75'. white, 8',	83'	97'		
19.	Slate,	5'			
20.	SS. red,	9'			
21.	Slate,		26'		
22.	SS. red, 67'. white, 15',		82'		
23.	Slate,		20'		
24.	SS. dark gray,		25'		

This section is made from the record of the Waynesburg gas well, which was kept in such a manner that the horizon of the *Ferriferous limestone* can only be fixed approximately in it. Calculating from the Waynesburgh coal, which was found in the well at 100', the sandstone at 1020' would seem to represent the *Mahoning SS.*, and the next one below it the Freeport.

At 1425' another massive sandstone appears which contains salt water, and whose sand-pumpings resemble *Homewood SS.* If this last be the Homewood, the Ferriferous limestone should be due at about 1350' (where I have located it in the section), and as the red of the *Mountain limestone* comes in at 1525', *it follows that both the Connoquenessing and Sharon sandstones are wanting here.*

In the driller's record only 10′ of "White lime" was el, but fortunately I secured a number of specimens ken between the depths of 1550 and 1767, all of which ve on test to belong to the Siliceous (Mountain) lime- ne. Probably the limestone does not end with my last cimen, but allowing that it goes no deeper, it is evident at the Mountain limestone group is *much thicker here* an at Washington and Pittsburgh.

The red rock at the top is a feature not noticed at Pitts- rgh, where the upper part is very dark, but can be seen a brownish limestone at Beaver Falls and in Parkinson ell, and is also very distinctly shown in a red slaty lime- ne in the Murraysville district. In the Farmington well, V. Virginia, about 27 miles due south from Waynesburg, d 15 miles beyond the Penna. State line, this red is re ted as 80′ thick and the underlying limestone 100′

Comparing the Waynesburg with the Pittsburgh section ther a remarkable similarity of structure is observable in e measures lying below the Mountain limestone. The stance from the latter to the Oil group varies but little, and e Butler "Gas sand" is well represented in both sections.

As the Waynesburg record reads, there would seem to e a great deal of sandstone in the Oil group, and the ater part of it is called "red sandstone;" but whether was really a massive red sandstone, or gray sand in a rix of red clay, or merely a sandy slate, we have no ans of knowing. At all events, it was barren of oil; and ay be remarked in passing, that *red-clay sands give y little hope of oil or gas.* A large increase of red, a ing of the lower sands into many members and a con ent increase of the thickness of the Oil group, has always, ar as experience goes, proved fatal to the oil deposits. structure is shown in many of the dry holes between ch and Elk county. See plate VII., report I5)

aring this section with No. 15 one might reasonably at the last two sands represent the Stray and Third of Thorn Creek. If they do, the Third has changed a white and pebbly to a brownish gray, fine grained which does not look like an oil rock, but is sand, n

In the driller's record only 10′ of "White lime" was noted, but fortunately I secured a number of specimens taken between the depths of 1550′ and 1705′, all of which prove on test to belong to the Siliceous (Mountain) limestone. Probably the limestone does not end with my last specimen. but allowing that it goes no deeper, it is evident that the Mountain limestone group is *much thicker here* than at Washington and Pittsburgh.

The red rock at the top is a feature not noticed at Pittsburgh, where the upper part is very dark, but can be seen in a brownish limestone at Beaver Falls and in Parkinson well, and is also very distinctly shown in a red slaty limestone in the Murraysville district. In the Farmington well, W. Virginia, about 27 miles due south from Waynesburg, and 15 miles beyond the Penna. State line, this red is reported as 80′ thick and the underlying limestone 100′

Comparing the Waynesburg with the Pittsburgh section rather a remarkable similarity of structure is observable in the measures lying below the Mountain limestone. The distance from the latter to the Oil group varies but little, and the Butler "Gas sand" is well represented in both sections.

As the Waynesburg record reads, there would seem to be a great deal of sandstone in the Oil group, and the greater part of it is called "red sandstone;" but whether it was really a massive red sandstone, or gray sand in a matrix of red clay, or merely a sandy slate, we have no means of knowing. At all events, it was barren of oil; and it may be remarked in passing, that *red-clay sands give very little hope of oil or gas.* A large increase of red, a splitting of the lower sands into many members and a consequent increase of the thickness of the Oil group, has always, as far as experience goes, proved fatal to the oil deposits. This structure is shown in many of the dry holes between Pittsburgh and Elk county. (See plate VII., report I⁴.)

Comparing this section with No. 19 one might reasonably infer that the last two sands represent the Stray and Third sands of Thorn Creek. If they do, the Third has changed from a white and pebbly to a brownish-gray, fine-grained sand which does not look like an oil rock, but is said, nevertheless, to have shown good indications of oil just before the tools were lost.

Section No. 24.—Murraysville, Westmoreland Co.

No.	Stratum	Thickness	Group	Thickness	Depth
1.	**Ferriferous limestone.**				
2.	**Thin-bedded sandstone,**				**40'**
3.	**SS. white, massive. Homewood type,**			**55'**	**95'**
4.	**Dark slate and white sand,**			**20'**	**115'**
5.	**SS. white, massive. Connoquenessing type,**			**75'**	**190**
6.	**Coal slate and white sand,**			**20'**	**210'**
7.	**SS. white massive. Connoquenessing type,**			**50'**	**260**
8.	**Sandy slate, dark, fossils and lime,**			**30'**	**290**
9.	**Siliceous limestone, gray,**	**25'**	**Mountain limestone,**	**150'**	**440**
10.	**Slaty limestone, dark,**	**15'**			
11.	**" " red,**	**20'**			
12.	**Siliceous " white,**	**70'**			
13.	**" " gray and brown,**	**20**			
14.	**Sandy slate, dark,**			**60**	**500'**
15.	**SS. gray, micaceous,**	**80'**	**Mountain sand,**	**200'**	**700'**
16.	**" yellowish, hard**	**40'**			
17.	**" white, friable,**	**80'**			
18.	**Sandy slate and slate,**	**225'**	**Crawford shales,**	**337'**	**1037'**
19.	**SS. yellowish, Butler Gas sand,**	**45'**			
20	**Slate, gritty,**	**67'**			
21.	**SS. "Murraysville Gas sand"—1st Venango Oil sand**			**13'**	**1050'**

This sand (No. 21) in Munhall well 4 miles west of Murraysville is 102' thick. East of Murraysville it is said to be thicker. At Murraysville the tremendous pressure of gas has prevented deeper drilling than about 25 feet—consequently we do not know what the structure of the lower part of the Venango Oil group may be in that locality.

The section should not be viewed as an exact representation in all of its details of the underground structure at Murraysville. It is made from the specimens preserved from Murray well No. 2, but they were taken at too wide intervals, and I have reason to suspect with not sufficient care. The main features, however, are sustained by other records, and the prime facts needed in this comparison of sections—the location of the Mountain limestone and the Butler Gas sand, can be depended upon.

The place of the Ferriferous limestone can only be indicated provisionally as the specimens do not show it definitely; but the *Homewood* and *Connoquenessing sandstones are* shown very characteristically. *The Sharon-Olean conglomerate seems to be wanting, as at Pittsburgh.* The

Mountain limestone is largely developed and accompanied by twenty feet of very decided red slaty limestone, which, as before remarked, increases in volume towards the south. I suspect that some of the specimens in this horizon have been wrongly numbered and that the red should appear on top of the limestone: but this would not alter the thickness of the mass and cannot invalidate any of the deductions to be drawn from the section in relation to the *First Oil sand*, which lies here 597′ below the Mountain limestone. At Pittsburgh it is 620′; at Washington 625′; at Parkinson well 671′ and at Waynesburg 645′.

We have now traced the Venango Oil group from Tidioute, in Warren county to Waynesburg, Green county, a distance of about 130 miles in an air line, and have seen that the *First Oil sand is persistent and easily recognized along the whole range*, although it has passed under other names in some localities It comes up to daylight in the valley of Hosmer run, just on the line between Spring Creek and Pittsfield townships, Warren county, where about 15′ of massive conglomerate is exposed at an altitude of 1430′ above ocean. (See I^4 p. 250.) From this spot it may be followed in drill holes, step by step, to Waynesburg, where it lies 2305′ beneath the surface, 1385′ below ocean level and 2815′ lower than at our starting point, as seen in the following table.

Dip of Venango First oil sand.

Altitudes + or — ocean level.	LOCALITIES.	Total fall.	Dist. miles.	Rate per mile.
+ 1430′	Hosmer Run to Church Run.	330′	13	25 ′ +
+ 1100′	Church Run to Franklin,. .	377′	18	21 ′ —
+ 723′	Franklin to Bullion Run,. .	83′	10	8½ —
+ 640′	Bullion to Petrolia, . .	521′	18	29 ′ —
+ 119′	Petrolia to Great Belt City,.	285′	14	20 ′ +
— 166′	Great Belt City to Pittsburgh,	624′	28	22 ′ +
— 790′	Pittsburgh to Washington, .	360′	23	16 ′ —
— 1150′	Washington to Waynesburg. . . .	235′	20	11½′ +
— 1385′	Waynesburg. . .			
+ 1430′	Hosmer Run Warren county, to.			
— 1385′	Waynesburg, Greene county,	2815	137	20½′

The First Oil sand is now producing a greenish-black oil of 46° gravity in Eldred township, Warren county, and a dark-amber oil of 47½° gravity in Venango county, between Titusville and Pleasantville. The celebrated lubricating oil of Franklin—of a dark brownish-green color and 32° gravity—comes from it, while at Washington the oil is a very light amber color and of 52° gravity. It has also proved somewhat productive in several other places, but never in profitable quantities where the lower part of the oil group is fully developed.

The position of the Venango Oil group in relation to the Ferriferous Limestone is shown by the following figures, which indicate a gradual thickening of the intervening measures, particularly in the southerly part of the field where the Mountain Limestone is largely developed.

Distance from the Ferriferous limestone to First Oil sand.

Section.		
No. 3.	*Great Bend (455′ below Olean conglom. add 325′ to Ferrif. Lime.),	780′
No. 4.	*Warren (468+325),	793′
No. 5.	Tidioute (480+325),	805′
No. 6.	Church Run (510+325),	835′
No. 8.	*Jamestown (490+325),	815′
No. 12.	*Howe township (456+325),	781′
No. 13.	*Marienville (553+325),	878′
No. 14.	Bullion Run.	870′
No. 15.	Brady township,	885′
No. 16.	Mercer township,	861′
No. 17.	Petrolia,	916′
No. 18.	Edenburg,	841′
No. 19.	Thorn Creek,	949′
No. 20.	Pittsburgh,	961′
NO. 21.	Washington,	980′
No. 22.	Mt. Pleasant township,	953′
No. 23.	Waynesburg,	1005′
No. 24.	Murraysville,	1037′

A line drawn from the northwest corner of Warren county to the northeast corner of Clarion county would approximately locate the northeastern end of the productive portion of the Venango Oil group. Northeast of this line no paying oil well has ever been found in rocks lying in its horizon—all the oils of eastern Warren, McKean and Allegany, coming from older and deeper strata. Southwest and south of this line it is the great oil and gas-bearing group of the country, and persistent drilling below it has failed to disclose anything that betokens a paying oil horizon in the measures beneath. The Speechley gas sand (about 900′ below the Oil group), underlies a large area between the Oil Creek and Clarion belts, and when first discovered seemed to promise oil; so far, however, after pretty thorough and wide-spread development, it appears to have responded only with tremendous outflows of gas.

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* At some of these points the location of the First Oil sand may possibly be open to question.

Southward from the Speechley district some oil and gas is found in sands lying above the Venango group, but in so small quantities, as compared with the yield of the latter, that these upper horizons cannot be regarded as of much practical importance as possible sources of new supplies.

Taking a general view, then, of this southern field, under all the light that past developments have thrown upon its underground structure and its possibilities, it would seem that its future as an oil and gas-producing region must be dependent almost entirely upon the scope of the Venango Oil group, and its ability to respond to the excessive demands that are likely to be made upon it—since the rocks above it cannot be expected to add very materially to the output, and the rocks below it, judged by present developments, give little or no indications of producing either oil or gas.

CHAPTER VI.

Notes relating to Natural gas wells and Pipe lines in the vicinity of Pittsburgh prior to January 1st, 1885.

The introduction of Natural gas into the City of Pittsburgh in the winter of 1883, and its successful application to domestic and manufacturing purposes, aroused capitalists to action and resulted in the drilling of many experimental wells in that region during the season of 1884. No Geological Survey of the Oil Regions was in progress at that time, but these new gas developments, in a region beyond the limits of the old oil fields rapidly became of so much importance that the Board of Commissioners deemed it advisable to order a special investigation to ascertain what had already been accomplished and to gather data for a future study of the field.

This work was done in December 1884, and inasmuch as none of the details have been published, a part of them will here be put on record as matters of history, and to show by comparison with present developments how rapidly the natural gas interests have grown during the last two years.

City of Pittsburgh and Allegheny Co.

January 1, 1885.

The following wells have been drilled in Pittsburgh, Allegheny City and along the Monongahela to McKeesport.

Boyd Hill well (see report I^3 page 398.)
McClintock (see report I^2 page 278.)
*Park Brothers.
*Painter & Sons
*Graff Bennett & Co.
*Jones & Laughlin's No. 1.
*Morehead & Co.

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*Complete records of those marked with an asterisk may be found in Chap. VII. All that could be learned concerning the others is given below.

Keystone Salt well.
Allegheny Salt well No 1.
" " " No 2.
Chess, Cook & Co.
Morton.
Cannon.
Souilliere.
Six Mile.
Tin Plate.
Black, McKeesport.
Elrod.
Wood.

All of these were sunk to the Salt water sand, which is here flooded with water, and several went far below it. None obtained gas of practical value, except Jones & Laughlin's No. 1, which tapped a deposit of considerable importance in a rock lying about 180′ below the Salt water sand.

Keystone well.

Probably about 1865.

At W. C. and J. M. Taylor's Keystone Salt works on Warsaw Street, Temperanceville, 36th Ward, Pittsburgh.

An old salt well drawing its supply from the great Salt water sand and now evaporating the brine with gas from the McGuigan well in Washington county.

Allegheny Salt well No. 1.

1865?

At Graham & Courtney's Manchester Salt Works, Corner of Beaver Avenue and Juniata St. Allegheny City.

An old well drilled about the year 1865 and afterwards deepened. Now said to be about 1760′ deep. It is still producing a large quantity of brine which comes, no doubt, from the great Salt water sand, struck in all the wells around Pittsburgh.

Allegheny Salt well No. 2.

An old salt well, drilled many years ago, on Western Avenue, near its intersection with Rebecca Street, in Allegheny City.

Chess, Cook & Co. well.

Nov. 1884.

On river bank between 19th & 20th streets, 26th Ward, Pittsburgh, South Side. Well mouth above ocean about 730′. A good set of specimens was kept from this well, but I was only allowed to examine two or three which contain limestone and belong to the same stratum as that found at about 900′ in the Boyd Hill well. One specimen representing 10′ is very pure carbonate, and more or less lime can be found through a thickness of over 50 ft.

Limestone specimen at,	850′
Top Salt Water sand "	1525′
Drilled on to,	1535′

Here the well filled up with salt water overflowing at a 2000 barrel rate and was abandoned.

Morton well.

On Howard Morton farm, 4 mile run, in 23rd Ward of City of Pittsburgh.

1600′ deep, and flooded with salt water. Some gas at 1580′. Recently finished.

Cannon well.

On the hill north of 9 mile run, about half a mile from the river at Salt Works station, in 22nd Ward, City of Pittsburgh.

A very strong flow of gas from the same horizon as the 618′ gas in Morehead & Co.'s well, but its volume diminished rapidly. Still drilling.

Souilliere well.

On Antoine Souilliere farm, Beck's Run, Lower St. Clair township, Allegheny county. about one mile from City limits of Pittsburgh. Dec. 12th Reported to have struck a strong vein of gas at about 700′ from the surface. Still drilling.

Six Mile Ferry well.

On the Risher farm, Street run, Mifflin township, Allegheny Co.

Said to be plugged with tools at about 1500′ and not yet down to the Salt water sand.

Tin Plate well.

1881?

At the Tin Plate works, near Demmler station B & O. R. R. in S. W. angle of North Versailles township Allegheny Co.

Said to be over 1600′ deep and abandoned on account of salt water.

Black well.

On 9th Street near the Youghiogheny in the borough of McKeesport—An old well.

Cased at 776′. A little salt water at about 1000′ but none in the great Salt water sand, being the only well on record that has failed to find water there. Salt water sand very fine and close; drillings like emery. Good show of gas at about 1060 feet Depth of well 1640′, perhaps deeper.

Bayard or Elrod well.

Near Elrod station, B. & O. R. R. north bank of the Youghiogheny river in South Versailles township, Allegheny county.

Well mouth about 18′ above river and 17′ below railroad.

(R. R. 752—17), ... 735

This was an old salt well, deepened in 1878. The record is from memory as given by Mr. Bayard and others.

Old Salt well record.

Well mouth above ocean in feet,		735
Coal 2½ ft thick at,	90′	645
" 6 " " "	140′	595
Two foot crevice and salt water of 5° with gas at,	468	+267
Sandstone from 730 to the bottom at,	1030	—295
Salt water of 8° strength with gas at,	850	—115

New well record.

Cased at,	500	to	500	+235
?	230	"	730	+ 5
SS. (salt water at 860; gas at 1140),	510	"	1240	—505
?	90	"	1330	—595
SS. gray, fine,	20	"	1350	—615
? (gas at 1408),	60	"	1410	—675

SS. gray and fine,	15	76 " 1486	—751
" blue,	10		
" white,	25		
" blue,	5		
" gray,	20		
" with pebbles,	1		

On the 30th of July 1878 I saw this well throwing a steady stream of brackish water through the open well mouth, as high as the top of the derrick. Since then several attempts have been made to make a gas or oil well of it but all have failed.

Wood well.

Located about 300′ from the Bayard Well.

Salt water at,	1350
Cased at,	1450
Gas at,	1401
Depth,	1500±

Flooded with water and abandoned.

Eighteen wells at Homewood and in that vicinity.

Jan. 1, 1885.

Westinghouse wells at Homewood.
Authority Mr. T. A. Gillespie.

Westinghouse well No. 1.

May 31, 1884.

In 21st Ward, Pittsburgh, between Martland and Lang Ave's. near Penn'a R. R. and near residence of Mr. Geo. Westinghouse.

Well mouth above ocean (barometer),	940′
Depth of gas sand,	1575′

A large flow of gas, but soon drowned out by water.

Westinghouse well No. 2.

Aug. 21, 1884.

In 21st Ward, Pittsburgh, east side of Lang avenue, at Homewood station, Penna. R. R.

Well mouth above ocean (8′ below station),	920

Salt water with little gas.

Westinghouse well No. 3.

Oct. 1884.

In 21st Ward, Pittsburgh, corner of Penn avenue and Galena St.

Well mouth above ocean (barometer), ... 975

A small gas well.

Westinghouse well No. 4.

Nov. 1884.

In 21st Ward, Pittsburgh, East side of Galena St. at Dallas sta. Penna. R. R., and on the Fahnestock Lead Works property—But little gas.

Westinghouse well No. 5.

Sept. 1884.

In 21st Ward, Pittsburgh, just north of the new Race track, and very near to the city limits.

Well purchased of J. M. Guffey and Co.

Well mouth above ocean (barometer), ... 965′

A fair flow of gas, said to be 1616′ deep, and 16′ in sand, cased at 953′.

Westinghouse well No. 6.

Jan. 13, 1885.

On the Blackadore farm, outside of the city limits and 1500′ North east from No. 5.

Well mouth above ocean (barometer), ... 1260

The drillers on this well report:

5′ of coal at	**104′**
8′ "	**785**
Cased and dry at,	**1267**
Top gas sand,	**1885**
Thickness gas sand,	**16 to 1901**

About same volume of gas as No. 5.

Westinghouse well No. 7.

Drilling, Jan. 1885.

In 21st Ward, Pittsburgh, and about 125′ north westerly from No. 1.

Pew and Emerson wells, now belonging to the Fuel Gas Company.

P. & E. well No. 1.

Summer, 1884.

In 21st Ward, Pittsburgh, on east side of Lang Avenue, about 500′ easterly from Westinghouse No. 1.

Well mouth above ocean (barometer), ... 955′

A small well at first, but said to be unproductive now.

P. & E. well No. 2.

Fall, 1884.

In 21st Ward, Pittsburgh, on north side of Grazier St. between Lang and Homewood Ave's. About 125′ east of Dillworth well.

But little gas.

Well mouth above ocean (barometer), ... 885′

P. & E. well No. 3.

Fall, 1884.

In 21st Ward, Pittsburgh, southwesterly corner of Homewood and Frankstown Ave's, and near the New Race course.

Well mouth above ocean (barometer), ... 925

A small gas well.

Dillworth well.

Fall, 1884.

In 21st Ward, Pittsburgh, on northeasterly corner of Lang avenue and Grazier street; about 125′ west of Pew and Emerson No. 2.

Owners the McCalmont Oil Company.

Well mouth above ocean (barometer), ... 885′

A little gas at first but drowned by water.

[This well was drilled to a depth of over 4700′ in 1886, when the tools were lost, and the hole abandoned.]

Spencer well No. 1.

Summer, 1884.

In 21st Ward, Pittsburgh, just west of the New Race course.

Said to be about 1620′ deep and to have had quite a show of oil, with some gas which was flooded by water. The well has been dismantled and the materials were used in well No. 2.

Spencer well No. 2.

Dec. 1884.

In 21st Ward, Pittsburgh, on Spring run, a branch of Negley's run between Lincoln Ave. Spencer Ave. and Upland St.

Well mouth above ocean (barometer), ... 880′

A very fair gas well, gas going to waste.

Asa Say well.

A well now drilling about 1200′ northeast of Westinghouse Well No. 6. Owners, the Wildwood Oil Co.

[This came in a good gas well but the gas was never utilized.]

*Laundry well.**

Spring of 1883.

South of Wilkensburg sta. Penna. R. R. and a little east of the city limits of Pittsburgh.

Well mouth above ocean, ... 900±
Depth about, ... 1600′

Salt water and a little gas which is still being used for light in the Laundry.

Hamilton well.

Summer, 1884.

At Brushton station, Penna. R. R.

Well mouth about station level—say, ... 925′
Depth about, ... 1615

A failure. Salt water flows over casing head.

***The location &c. of Laundry and Brushton wells are from Mr. T. A. Gillespie, who drilled some of them.**

Maloney or Pottery well.

Summer, 1884.

At Brushton sta. about 1000′ W. of Hamilton well. Same character as Hamilton, little sand and much salt water.

Zimmerman well.

Summer, 1884.

At Brushton sta. about 1000′ S. of Maloney well. Same character as the other two. No gas and much water.

Philadelphia, Westinghouse Gas Co.

This company has for its supply the seven Westinghouse wells at Homewood in 21st Ward Pittsburgh, (three good wells, three of little worth and one drilling) Three wells at Murraysville (one very large and two drilling) and one large well at Tarentum on the Bandy farm, which remains to be described with the Tarentum wells.

From Murraysville it has two 8 inch lines laid in the same trench and connected at intervals, for a distance of 3½ miles, to the Thompson farm, where the pipes are enlarged to 10 inches and continued 2½ miles farther to the Telford farm. Here they are enlarged to 12 inches and extended 4 miles to the Allegheny river at the mouth of Sandy creek, where three 8 inch lines cross the river to Hoboken and one 8 inch line is carried down the south side of the river 6 miles to Pittsburgh. At Hoboken a ten inch line, 14 miles in length comes down from the Bandy farm well at Tarentum. From Hoboken a 20 inch cast iron pipe is laid along the river 6 miles to Allegheny City and with this runs also a 10 inch wrought iron pipe. Between Allegheny and Pittsburgh there are a number of crossings. The Homewood gas is used principally for local purposes, but the network of pipes will be so connected that supplies can be drawn from Homewood, Murraysville or Tarentum at pleasure.

The mains from Murraysville and Tarentum are not yet completed. This company has secured a large amount of what is supposed to be gas territory and will no doubt, by new wells, be constantly adding to its supplies.

Murraysville Gas field

January 1, 1885.

This field embraces to-day eight producing wells, two drilling wells and two rigs located, all of which could probably be included within a parallelogram 300 rods long and 100 rods wide.

Two companies now control the field; "The Fuel Gas Company of Allegheny County" and "The Philadelphia-Westinghouse Gas Company" of Pittsburgh. The former has 7 producing wells and one drilling, and for some time have been supplying gas to customers in East Liberty. The latter has one large producing well, one drilling within a few feet of the gas sand and two more located. Their pipe line for delivery is not yet completed and consequently their gas is going to waste.

Fuel Gas Company's Wells.

1. *Haymaker well No. 1*, or "Old Gas well," located on H. Remaley's farm, north bank of East branch of Turtle creek about 40 rods above the Mill-dam at Murraysville. Gas struck Nov. 1878 at 1320′, and still flowing, it is thought, with unabated volume.

2. *Boulton & Doubleday No. 1*, on A. Remaley farm, about 800 feet west of Haymaker No. 1—completed March, 1883. A moderate well. (see record.) Gas wasting. [This well was deepened in 1886 and made a very large producer.]

3. *Hostetter & Brown, No. 1*, on the Harvey farm. A strong gas well. Completed June 1883; depth 1330±.

4. *Hostetter & Brown No. 2*, on the Harvey farm, about 800 ft. east of Haymaker No. 1 and on the same stream. A good well. Completed Nov. 1883; depth 1325′±.

5. *Pew & Emerson No. 1*, on the Meanor farm, about 200′ southeast of H. & B. No. 2, and on the creek bottom. A moderate well. Completed Aug. 1884; depth 1310′±.

6. *Hostetter & Brown, No. 2*, on the Stewart farm. A strong well. Completed Dec. 1884 and gas going to waste. Depth 1465′±.

7. *Pew & Emerson, No. 2*, Fundis farm, about half a mile from Haymaker No. 1. Completed Aug. 1882. Cased

at 625′. Top of gas sand 1418′. Depth of well 1425′. A very strong flow of gas.

8. *Fuel Gas Company No. 1*, Irwin farm, about three quarters of a mile northeast from Haymaker No. 1, and the most northerly well in the field. Drilling at a depth of 200 feet.

Philadelphia-Westinghouse Co.'s wells.

9. *Verner No. 1*, on the Verner farm, about 500′ northwest from Pew & Emerson's Fundis farm well. A very strong flow of gas. Not yet connected to pipe line.

10. *King No. 1*, on the King farm, about 150′ northeast from Haymaker No. 1. Now drilling near the gas sand. [This proved to be a very large well.]

11. *Cryder, No. 1*, on the Cryder farm, midway between P. & E. No. 2 and H. & B. No. 3. Rig built.

12. *Fundis well*, on Fundis farm, between P. & E. No. 2 and the village. Rig building.

Gas Lines from Murraysville.

The Fuel Gas Company has its first station at Thompson's, about a mile and a half from Murraysville. Between this point and the wells there is one 5⅝-inch line, one 8-inch and one 10-inch. At Thompson's these pipes connect with a 5⅝-inch line from Lyons Run well, and all are so united by cross connections and controlled by gates, that the gas from any one can be shut off entirely, or transferred at pleasure from one line to another. Hence no interruption occurs when one line needs repairing, for the others can be made to do the work. From Thompson's three lines lead to Gilmore, a station about one mile from the city limits. These pipes are about ten miles long, being respectively 5⅝, 8 and 10 inches in diameter. From Gilmore they run into the city, ramify through the streets, serving many customers by the way, and reaching the Monongahela, three 6-inch lines and one 8-inch line are carried across it to supply the mills on the south side.

In addition to the above, this company has a "Twin Line," (two 5⅝-inch pipes laid in the same trench, and so connected at intervals that the gas can be transferred from one to the other when breaks occur and repairs are necessary) running direct from Murraysville to Pittsburgh.

These lines take all the gas now being utilized from the company's six producing wells in the Murraysville field, and one well on Lyons Run. Considerable gas is going to waste from these wells, and the other productive wells—Boulton & Doubleday No. 1 and Verner No. 1—(the latter a very large well) are not yet connected with any line.

No receivers or drip-tanks are used at the wells of this company, the gas being delivered direct from the wells to the pipe lines. The waste-escapes at the wells are regulated by safety-valves under a pressure of 150 to 190 lbs. to the square inch. Experimentally, the pressure has been increased for a short time to 250 lbs. But the maximum, with the gas all shut in the well, has never been ascertained, for none of the wells are cased and equipped in such a manner that it would be safe to make the test.

Lyons Run Gas Field.

January 1st, 1885.

About two miles S. 25° W. from Murraysville lies the gas field of Lyons Run, in which there are three wells producing largely, one shut down on top of the sand, one drilling and one rig up—six in all.

Haymaker's Lyons Run Well No. 1, on the Joshua Cooper farm; a very large producer struck early in 1883 and afterwards sold to Pew & Emerson. It is now connected with the Fuel Gas Company's line, as before mentioned. Elevation of well mouth above ocean, as ascertained by spirit levels from Carpenter's station, 870′ feet. Depth to gas sand about 1300 feet.

Boulton & Doubleday No. 1, J. Cooper farm; a large well. Gas piped by the Acme Gas Co. to the Edgar Thompson Steel Works at Braddocks. See record.

Boulton & Doubleday No. 2, J. Cooper farm. Very strong gas. Sand struck at 1310′. Connected with Acme Gas Company's line.

Boulton & Doubleday No. 3, J. Morrow farm; shut down near top of sand because not needed at present.

National Tube Works, well No. 1, J. Cooper farm; now drilling.

Hostetter & Brown. Rig built.

These wells cover a space on the gas belt about 80 rods long and 40 rods wide, and in the intervening two miles between them and Murraysville no drilling has been done.

Acme Gas Company.

From Boulton & Doubleday's wells Nos. 1 & 2, an 8-inch gas main is laid to the Edgar Thompson Steel works at Bessemer station, on the Penna. R. R. Length about 9 miles. Thence a 6-inch line is carried through Braddocks to Miller's Forge, where it crosses the Monongahela diagonally, to the Homestead Steel works. This part is about 3 miles long, and supplies gas to over 100 families in Braddocks before the Steel works are reached. A 4½-inch line is extended about a mile and a half farther, to Bryce, Higbee & Company's Table Glass Works and the City Poor Farm's buildings.

The heating capacity of the gas delivered at the Edgar Thompson Steel Works equals 400 tons of coal per day. That is, 400 tons of coal per day were formerly consumed in this establishment in keeping up the same fires that are now run by gas. The total delivery through this company's pipes equals about 500 tons of coal per day, or at 26 bushels to the ton the daily heating power of the gas is equivalent to 13000 bushels of coal. This gas all comes from two wells, where a large surplus is constantly going to waste, It is thought that double the quantity could be carried through the Acme's mains if consumers required it.

The Acme's pipes are all of wrought iron, (the 8-inch weighing 22 lbs. to the foot) laid in trenches three feet deep. The first pipe was laid Aug. 21st, 1883, and the first gas delivered at Braddocks Dec. 1st, 1883, at which time but one other Natural Gas Pipe Line (the Penn Fuel Company) was in operation in the vicinity of Pittsburgh.

To shut off the salt water coming from the 30′ sand lying

80′ above the gas sand in well No. 1 (see record) a 4-inch pipe with a packer similar to those used in oil wells was inserted, and the gas now flows through a curved pipe from this 4-inch tube into the top of a vertical gas receiver about 30 inches in diameter and 8 feet high. The tube is continued down in the receiver to within a short distance of the bottom and the gas is delivered to the pipe line through a connection near its top. A pressure-gauge and safety-valve on top give the means of regulating the pressure in the receiver. The safety-valve is weighted at 150 to 200 lbs. to the square inch as circumstances require, and the wells are generally not only "blowing off" at the safety-valve, but also losing large quantities of gas at the waste pipe which connects directly with the casing head, and is governed by a stop-cock so that the proper pressure in the receiver may be regulated as desired. The bottom of the receiver is connected by a small pipe with stop-cock to a horizontal tank below it, which will contain about two barrels. Into this tank the drippings from the receiver fall, and once a day the stop cock in the pipe between the two receptacles is closed and the water drawn off. Although the gas seems perfectly dry as it comes from the well, about eight pails full of salt water are drawn from this tank every day. The water, under pressure, comes out as white as milk, but soon becomes clear and colorless.

Well No. 2 was cased with 6½-inch pipe to a depth of about 560′ and then a 6¼-inch hole drilled to 1280′, where heavy 4¾-inch pipe was inserted to shut out the water from the 30′ sand mentioned above. Thence a 4⅝-inch hole was continued to the bottom.

After the well had been connected to the line it was discovered that when the gas was confined in the well under a pressure of 160 lbs. to the square inch, salt water made its appearance. It was, therefore, deemed advisable to draw the casing, as the packer was supposed to be defective. This packer was of lead and it anchored the casing so firmly that it could not be started by all the power that could prudently be applied to it without endangering the derrick. It was then suggested that a gas-gate be screwed to the casing head and closed so that the gas pressure might assist in starting the casing. The gate was put on, but on attempting to shut the valve, the gas bent it in such a shape that it could be only partly closed. It increased the pressure in the well, however, and loosened the casing The gate had been tested under a pressure of 500 lbs. to the square inch before leaving the hands of the manufacturer.

The National Tube Company of McKeesport, have purchased the larger portion of the Joshua Cooper farm at Lyons Run and are now drilling a gas well, as mentioned above, and laying a pipe line direct to their works at McKeesport. The laying of an expensive pipe line before gas has been obtained is a new phase of the gas business, but in this case there can be little risk incurred for their drilling well is in the center of Lyons Run pool and cannot fail to prove largely productive. Both well and pipe line will soon be completed.

Southwest of Lyons Run.

January 1st, 1885.

Following the Murraysville anticlinal towards Carpenter's Station, four wells have been drilled by the Carpenter Natural Gas Company, E. M. Hukill. President.

No. 1. The Lentz farm well near Carpenter's Station found the gas rock flooded with water. (See record.)

No. 2. On the Dick farm, within a mile from Lyons Run, has a moderate flow of gas. (See record.)

No. 3. On the McWilliams farm, about 45 rods from Dick farm well, is a large producer.

No. 4. On the Daum farm, still farther southwest is a very powerful well, probably the largest in the field.

The Carpenter Natural Gas Co.

From wells Nos. 2, 3 and 4, an 8 inch, heavy, wrought iron pipe line runs southwesterly and then westerly cutting the Penna. R. R. just west of Stewarts Station and the B. & O. R. R. at Port Perry, where it crosses the Monongahela diagonally and passing on through Mifflin and Baldwin townships, enters Pittsburgh, South side, at the east end of Birmingham, on Carson street. It will be carried through the South side to supply the mills and dwellings there—the city pipes being laid and owned by D. McKay Loyd & Company, Limited.

Between Stewarts Station and the river, a branch diverges from the main line to McKeesport, and connects with the extensive Rolling mills of W. D. Wood & Co. This line will be in operation in a few days.

At present the flow of gas from these three wells seems to be equal to all the requirements of the pipe line. The wells flow into strong wrought iron receivers similar to those before described and everything about the plant has been done in the most thorough and workmanlike manner.

RECAPITULATION.	Connected with pipe lines.	Not in use.	Drilling.
Murraysville.			
Fuel Gas Co.,	6	1	1
Philadelphia-Westinghouse Co.,	....	1	3
Lyons Run, &c.,			
Fuel Gas Co.,	1	....	1
Acme Gas Co.,	2	....	1
National Tube Co.,	.	....	1
Carpenter Natural Gas Co.,	3	...	....

Total 12 wells utilized—2 wells gas wasting—7 wells drilling or preparing to drill.

Hickory Gas Field, Washington Co.

January 1st, 1885.

The Niagara Oil Company of Buffalo, C. D. Robbins, General Manager, has secured very large leases in Washington county, and put down the following wells, the records of which are given elsewhere.

McGuigan No. 1, Mount Pleasant twp. S. W. of center
Buchanan, Cross Creek township, S. E. of center
Rush, Hopewell township, W. of center

Emery, Mount Pleasant township, central part
Miller, " " " " "
Scott, Cecil township, N. W. of center
Donaldson, Mount Pleasant township, central part
Carlisle, " " " " "
McGuigan No. 2 Rig up Dec 27, 1884.

McGuigan No. 1, Emery and Miller are large gas wells; Buchanan, Rush and Scott are unproductive, and Donaldson and Carlisle are drilling.

Chartiers Natural Gas Co.

This company is laying a gas line from the Miller, Emery and Donaldson wells to Pittsburgh and work is already far advanced. The line will be about 21 miles long. From the wells to Mansfield Junction, 8 inch pipe is used, from the junction to South side, 10 inch. These three wells have a fine flow of gas, and they develop an area sufficiently large to make it certain that the pool is an extensive one. The gas comes from a higher rock than the McGuigan and Washington gas, and it is probable that deeper drilling will give an increase in one or other of these underlying sands.

Ford & Nelson Gas Line

January 1st, 1885.

Messrs Ford & Nelson purchased the McGuigan well of the Niagara Oil Company in 1882, and also secured the fee simple in three acres of land surrounding it. They have laid a 6 inch pipe line, 22 miles in length from the well to South side, Pittsburgh and are furnishing fuel to Taylor's Salt Works at Temperanceville, J. Painter & Sons' Iron Works, South side, and about 50 families by the way. As the product of the well cannot all be utilized through this pipe, they are now laying another 8 inch line in the same trench. Commencing at the Pittsburgh end the line had been completed about six miles out when winter set in and stopped the work. At this point it has been connected with the old main and now the delivery of gas through the two pipes, at South side is nearly double what it was before the new line was laid. This seems to prove that the capacity of gas pipes should be increased towards the delivery end.

From the casing head of the McGuigan well a 6 inch pipe leads to a strong wrought iron receiving tank from which the gas is delivered to the Pittsburgh main. There is also, a 3½ inch waste-pipe controlled by a stop-cock so that the gas not needed in the line may be allowed to escape. On top of the tank are a weighted safety-valve and a pressure gauge. With the gauge registering 193 lbs to the square inch, the well throws out a large amount of surplus gas through both the safety-valve and the waste pipe. A little pipe with a stop-cock delivers the water drippings from the bottom of the receiver. The drippings look like milk, feel greasy, have an odor of petroleum and are very salt. They probably amount to 5 barrels or more per day. The water loses its milky appearance after leaving the tank and a slight oily scum is seen on the stream below.

The gas burns at the waste pipe with a dark rich flame, making considerable smoke. It has rather a fetid odor, but a faint smell like petroleum can be detected.

Washington Light & Heat Co.

January 1st, 1885.

This Company own three wells in Canton township about a mile northwesterly from the Borough of Washington, the county seat of Washington county.

No. 1, Hess well; now producing gas, (see record)
No. 2, Hervey well " " " " "
No. 3, Hough well now drilling at about 1350'

The Hess well was completed on the 29th of April, 1884. It is located on the Hess farm about a mile and a quarter N. N. W. from the Chartiers R. R. depot at Washington, and on the easterly bank of Chartiers Creek.

Hervey Well, completed Sept. 1884, on Chartiers Creek, one mile N. E. from Hess well.

Hough Well, now drilling nearly midway between the first two and in the same line.

A pipe line has been laid from Nos. 1 & 2, and gas is now being used in many stoves and grates in Washington, but the details of the enterprise the Superintendent declines to give.

Citizens Natural Gas Co. of Washington.

At Gantz's Mills, about 20 rods from the Chartiers R. R. depot at Washington, this Company is drilling a well which struck sand and made a show of oil on the 1st of January 1885. (See record.)

Tarentum Gas Wells; all in Allegheny Co.

Jan. 1, 1885.

The following productive gas wells have been drilled on Bull creek in the Tarentum Gas Field, but the Westinghouse wells are the only ones connected by pipe with Pittsburgh.

Graff, Bennet & Co. (Old Tarentum Well).
Ford & Nelson No. 1.
" No. 2.
Richards & Hartley.
Penna. Salt Manufacturing Co. No. 1.
" " No. 2.
" " No. 3.
Guffey & Galley Wehrle farm (now P. S. M. Co. No. 4.)
Godfrey & Clark.
Tarentum Heat & Light Co.
Guffey & Gally No. 1. Bandy farm (now Westinghouse No. 1.)
Wilson Well No. 1. Christ farm.
Philada. Westinghouse Co. No. 2.
" " No. 3.

Only fragmentary and imperfect records can be obtained but they serve to show the extent of developments, and prove the existence of a large bed of gas producing sandrock in that region.

Graff, Bennett & Co., Old Tarentum Gas well.

June, 1878.

See Report I', page 405.

This well has ceased to produce gas, but it is supposed that the stoppage is occasioned by the closing up of the well bore with the limy deposits made by the water accompanying the gas, and is not due to a failure of the gas supply.

Ford & Nelson well No. 1.

Feb. 1883.

On the Smith farm, Bull creek, near the southwestern line of Fawn township.

Depth of Well,	1147 ft. 8 in.

As soon as the top shell was pierced, at 1140 feet, the gas came so suddenly that the rig caught fire and was consumed.

This is a large well and the gas from it is being used by the Pittsburgh Plate Glass Company, whose works have been located near Tarentum.

Ford & Nelson well No. 2.

July, 1883.

On the Coe farm, Bull creek, Fawn township, about one mile above Ford & Nelson's No. 1.

A good gas well. Gas used by the Plate Glass Co. in connection with well No. 1.

Richards & Hartley well.

Nov. 1883.

On the Wehrle farm, Bull creek, Fawn township.

A good flow of gas, which is piped to Tarentum and used in the Company's Bottling Works.

Penna. Salt Manufacturing Co. well No. 1.

Sept. 1883.

In Fawn township, on Bull creek, near the mouth of McDowell's Run.

Moderate flow of gas.

Penna. Salt Manufacturing Co. well No. 2.

July, 1884.

In Fawn township, on Bull creek, a short distance above well No. 1.

Moderate flow of gas.

Penna. Salt Manufacturing Co. well No. 3.

Oct. 1884.

In Fawn township about three quarters of a mile southwest from Well No. 1.

A small gas well.

Penna. Salt Manufacturing Co. well No. 4.

July, 1884.

Drilled by Guffy & Gailey on the Wehrle farm, Bull creek, Fawn township, and by them sold to the Salt Manufacturing Co.

Cased at 400'-Depth (6 inches in sand), ...	1179

A good gas well.

The Salt works of the Penna. Salt Manufacturing Co. are located at Natrona, on the Allegheny river, about two miles above Tarentum, and the gas produced by these four wells is piped there for their own consumption.

Godfrey & Clark well.

March, 1884.

On the Hair farm, valley of Bull creek, about half a mile above the mouth of Little Bull creek.

The well makes a good flow of gas, which is piped to the Company's Paper mill near the river at Tarentum.

Tarentum Heat & Light Co. well.

Aug. 1884.

On the Leslie farm, Harrison township, just above the confluence of Little Bull creek with Bull creek.

Depth, ...	1109'

A good well. Gas piped to the patrons of the Company in Tarentum.

Philada. Westinghouse Co. No. 1.

Sept. 1884.

Drilled by Guffey, Gailey & Co. on the Bandy farm, Fawn township, east side of Bull creek about a mile and a half above the mouth of Little Bull creek, and after completion sold to the P. W. Co.

Cased at 790′ and perfectly dry afterwards.

Top of good coarse gas sand,	1180
Drilled to,	1197

This well is said to have the greatest flow and the dryest gas of any well in the field. It is connected by an 8 inch pipe with the P. W. Co.'s Murraysville line at Hoboken, about 14 miles from the well, as previously mentioned, and this is the only line now conveying gas from the Bull creek or Tarentum gas field to Pittsburgh.

Philada. Westinghouse well No. 2.

Jan. 1885.

On the Smith farm, Bull creek valley just above Ford & Nelson Well No. 1.

A good well—to be used in connection with Well No. 1.

Wilson well.

Sept. 1884.

On Fred. Christ's farm, Harrison township, east side of Bull creek and about ⅛ of a mile above mouth of Little Bull creek.

Authority Mr. A. P. Wilson.

Freeport Upper coal outcrops on level with well mouth.

SS. and shales to bottom of Mountain sand,	934	to 934
(Lowest salt water at 897. Cased at 915.)		
Shales and sandstone,	258	" 1192
"Cap rock" hard as flint,	3	" 1195
Shells,	9	" 1204
Gas sand, coarse; drilled in it,	1	" 1205

A large flow of gas which is going to waste. A company is being organized to pipe it to Pittsburgh.

Philada. Westinghouse well No. 3.

Drilling Jan. 1885.

On the Means farm about half a mile south from P. & W. Well No. 2.

Anderson well.

Jan. 1884.

Drilled by the Penna. Salt Manufacturing Co. on the Plumley farm, East Deer township, about two miles west of Bull creek. Gas sand flooded with salt water at 1194′ and well abandoned.

Anderson well.

March, 1884.

On Bull creek, Harrison township and not far from Graff, Bennett & Co.'s old Tarentum well.

Cased at 900′. Drilled to about 1200′.

Production, salt water, but no gas.

Avenue well.

July 1884.

On the Breckenbridge tract, east end of Tarentum village and about 20′ above the river terrace.

Gas sand at,	1160′

Sand flooded with water. The well was drilled below this sand and then abandoned.

Painter well.

June 1883.

On southwest corner of Painter farm, in Fawn township near the head of Little Bull creek, and about 3 miles northeast from Penna. Salt Manufacturing Co.'s well No. 1.

Freeport coal at,	198′
Butler 1st sand at,	1468′
Depth of well about,	1550′

Some oily smelling gas in the Butler 1st sand, but of no practical value. Well abandoned.

Campbell well.

June 1881.

Near Soda Works station on Allegheny Valley R. R. in N. W. corner of Burrell township, Westmoreland Co. and about 4 miles east by north from the old Tarentum well.

Well mouth above ocean (barometer),			780
Shale and Sand,	250 to	250	
Limestone reported at,		250	
Shale and sand,	65 "	315	
SS. (nearly all sand),	400 "	715	
Red shale,	20 "	735	
"First sand" (cased at 750′),	90 "	825	
Slate and shells; no good sands,	955 "	1780	
Depth of well about,		1850	

A little gas in some brownish sandy slate at 1770′ but not enough to be of any value. The Tarentum gas sand was represented by only a few thin sand shells. Well dismantled.

Breckenridge & Anderson well.

Aug. 1884.

In Burrell township, Westmoreland county, about a mile and a half southeast from Tarentum.

Flooded with water in the horizon of the Tarentum gas sand, and well abandoned.

Springdale well.

Nov. 1884.

In East Deer township, Allegheny Co. about ¾ of a mile north of Springdale sta. on the West Penn. R. R.

Salt water and no gas of value.

Hulton well.

Fall of 1884.

In Plum township, Allegheny Co. near Hulton Station Allegheny Valley R. R.

Salt water and no gas of value.

Spang & Chalfant well.

1875.

Near Sharpsburg, see report I‘ page 138.

Beaver County wells.

Jan. 1, 1885.

Vandergrift, or Bridgewater well No. 1.

Spring of 1884.

On the J. Zimmerly farm, in Moon township, Beaver Co., about 2 miles from New Sheffield, and six miles south by west from Rochester. On a little stream about a quarter of a mile above its junction with Raccoon creek.

Authority, Mr. T. J. Vandergrift, for all Beaver Co. wells.

Well mouth above ocean (barometer),				**860'**
Very soft drilling,	**300**	**to**	**300**	**=560**
SS. with some limestone,	**100**	**"**	**400**	**460**
Coal,	**5**	**"**	**405**	**455**
SS. (nearly all hard sandstone) much salt water,	**107**	**"**	**512**	**348**
Slate (cased at 515'),	**5**	**"**	**517**	**343**
SS. (nearly solid),	**133**	**"**	**650**	**+210**
Slate & shells,	**365**	**"**	**1015**	**—155**
SS. (some gas),	**35**	**"**	**1050**	**—190**
Slate, common,	**90**	**"**	**1140**	**—280**
Red shale, very red,	**40**	**"**	**1180**	**—320**
Slate,	**70**	**"**	**1250**	**—390**
SS. gas sand. Drilled in it,	**7**	**"**	**1257**	**—397**

A very large gas well. The gas smells strongly of petroleum and makes some drippings of amber oil.

The well now belongs to Bridgewater Gas Co.

Bridgewater well No. 2.

Summer 1884.

On the Bruce farm, Moon township, in the valley of Raccoon creek and about one third of a mile southwest from Bridgewater No. 1.

Geological structure similar to No. 1, but flow of gas much smaller.

Bridgewater well No. 3.

Fall of 1884.

On the Henry Zimmerly farm, Hopewell township, Beaver Co., in the valley of Raccoon creek and about one third of a mile southeast from Bridgewater No. 1.

Geological structure similar to No. 1, and volume of gas about the same as No. 1.

Bridgewater well No. 4.

Jan. 19, 1885.

On the Stein farm, Moon township, in the valley of Raccoon creek and about one-third of a mile west from Bridgewater No. 1.

The gas sand in this well was represented by only three or four feet of thin flaggy sandstone containing scarcely a puff of gas, and after drilling to a sufficient depth below, the well was abandoned as a failure.

Bridgewater, Gailey Bros. well.

Summer 1884.

Drilled by Gailey Bros. on the Bruce farm, (not the same Bruce as Bridgewater No. 2) in Moon township, Beaver Co., about 2 miles north from Bridgewater No. 1.

?	**1380**	**to**	**1380**
SS. blue, (gas sand of No. 1),	**5**	**"**	**1385**
? (no well defined sands),	**215**	**"**	**1600**
SS. blue, (smell of petroleum gas),	**5**	**"**	**1605**
Soft and uniform drilling,	**75**	**"**	**1680**

Dry. No water, no oil, and barely a smell of gas.

This record is of interest as it shows no promising sand beds for 300′ below the gas sand.

Bridgewater Gas Company.

January 1st 1885.

From wells Nos. 1, 2, & 3, the Bridgewater Gas Company has laid an 8 inch pipe line and the gas is now being extensively used in Phillipsburg, Rochester, Brighton, Beaver and Beaver Falls. The line is about eleven miles long and with an ample supply of gas and a large field for consumption promises to be an investment that will yield satisfactory returns.

List of wells drilled in Pittsburgh and the surrounding country, including Murraysville, Washington, Tarentum, Beaver &c. prior to January 1st 1885.

Allegheny County.

1. Boyd Hill, Pittsburgh, (see I^3 page 398).
2. McClintock, Manchester, (see I^2 page 278).
3. *Parke Brothers, Pittsburgh.
4. *Painter & Sons, South Side.
5. *Graff, Bennett & Co. South Side.
6. *Jones & Laughlin's No. 1 South Side.
7. *Morehead & Co. Pittsburgh.
8. Keystone, Temperanceville.
9. Allegheny Salt Co. No. 1, Allegheny.
10. " " " No. 2, "
11. Chess, Cook & Co. South Side.
12. Morton, Pittsburgh.
13. Cannon "
14. Souilliere, Lower St. Clair township.
15. Six Mile, Mifflin township.
16. Tin Plate, North Versailles.
17. Black, McKeesport.
18. Bayard, Elrod Station.
19. Wood " "
20. *Munhall, Patton township.
21. *Wall Station, North Versailles township.
22. *Munhall, Jacks Run, S. Versailles township.
23. *Bissell South Versailles township.
24. *Vandergrift South Versailles township.
25. *Weston " " "
26. *Black " " "
27. *Graff, Bennett & Co. No. 1, Millvale.
28. * " " " No. 2 "
29. Lead works, Mansfield.
30. *Guffey & Co. Ross township.
31. *Hukill No. 1 Pine creek, Shaler township.
32. Graff, Bennett & Co. No. 1 Tarentum.
33. Foed & Nelson No. 1 "
34. " " No. 2 "
35. Richards & Hartley "
36. Penna. Salt Man'f't'g Co. No. 1 Tarentum.
37. " " " " 2 "
38. " " " " 3 "
39. " " " " 4 "
40. Godfrey & Clark. "
41. Heat & Light Co. "
42. Philada. Westinghouse Co. No. 1 Bandy farm Tarentum.
43. " " No. 2 Smith " "
44. " " No. 3 Means " "
45. Wilson, Christ. "
46. Anderson, P. S. M. Co. "
47. " Bull Creek. "
48. Avenue Tarentum. "
49. Painter, Fawn township.
50. Springdale, East Deer township.
51. Hulton Plum "

52. Sharpsburg. (see I^{4} page 138).
53. Westinghouse No. 1 Homewood.
54. " No. 2 "
55. " No. 3 "
56. " No. 4 "
57. " No. 5 "
58. " No. 6 "
59. " No. 7 "

60. Pew & Emerson No. 1 Homewood.
61. " " No. 2 "
62. " " No. 3 "
63. McCalmont Oil Co. No. 1 Homewood.
64. Spencer No. 1 "
65. " No. 2 "
66. Wildwood Oil Co. No. 1 "
67. Laundry, Wilkensburg.
68. Hamilton, Brushton.
69. Maloney "
70. Zimmerman "

Westmoreland Co.—Murraysville &c.

71. Haymaker No. 1 Murraysville.
72. *Boulton & Doubleday No. 1 Murraysville.
73. Hostetter & Brown No. 1 "
74. " " No. 2 "
75. " " No. 3 "
76. Pew & Emerson No. 1 "
77. " " No. 2 "
78. Philada., Westinghouse Co. No. 1 Murraysville.
79. " " " No. 2 "
80. Haymaker No. 1, Lyons Run.
81. *Boulton & Doubleday No. 1 Lyons Run.
82. " " No. 2 " "
83. " " No. 3 " "
84. *Hukill No. 1 Dick farm " "
85. * " No. 2 Daum " " "
86. * " No. 3 McWilliams " "
87. * " Lentz farm Carpenter's Station.
88. *Irwin Station, Penn township.
89. *Parnassus, Burrell township.
90. *Beaver Valley, Washington township.
91. Breckenridge & Anderson, Burrell township.
92. Campbell, Chartiers " "

Washington County.

93. *McGuigan, Mount Pleasant township.
94. *Buchanan, Cross Creek township.
95. *Rush, Hopewell township.
96. *Emery, Mount Pleasant township.
97. *Miller, Mount Pleasant township.
98. *Scott, Cecil township.
99. *Donaldson, Mount Pleasant township.

100. *Carlisle, Mount Pleasant township.
101. *Canonsburg
102. *Hess, Canton township.
103. *Hervey " "
104. *Hough " "
105. *Gantz " "

Beaver County.

106. J. Zimmerley, Moon township.
107. Bruce, Moon Township.
108. H. Limmerley, Hopewell township.
109. Stein, Moon township.
110. Bruce, Moon township.

Total 110 wells and probably several have been overlooked.

During the intervening two years to January 1st 1887, about 400 new wells were drilled in this region. In the Washington and Shannopin fields 289 wells were reported in 1886. Over 60 new holes have been drilled on the Murraysville belt. Probably 20 in the vicinity of Tarentum and no doubt as many as 30 more in different parts of the district.

The Natural Gas companies in operation January 1st 1885 and actually piping gas into the City of Pittsburgh are as follows:

1. *Fuel Gas Co.*—a consolidation of the interests of Pew & Emerson, the Penn Fuel Co, and Hostetter & Brown. Conveying gas from 6 wells at Murraysville and 1 at Lyons Run.
2. *Acme Gas Co.* Conveying gas from 2 wells at Lyons Run.
3. *Carpenter Natural Gas Co.* Conveying gas from 3 wells, Lyons Run extension.
4. *Philadelphia-Westinghouse Co.* Conveying gas from 6 wells at Homewood and 2 at Tarentum. (Nearly ready to connect with Murraysville).
5. Ford & Nelson, Conveying gas from 1 well (the McGingan) in Washington County.

Recapitulation.

Murraysville	**6**	**wells in use.**
Lyons Run	**5**	**" " "**
Homewood	**6**	**" " "**
Tarentum	**2**	**" " "**
Washington Co.	**1**	**" " "**
Total	**20**	**" " "**

*** Records of these wells may be found in next chapter.**

Lines rapidly nearing completion.

Chartiers Gas Co. From Hickory, Washinton County to Pittsburgh. Two producing wells ready to connect.

National Tube works. From Lyons Run to McKeesport. One well nearly completed.

Tarentum Gas Lines.

Ford & Nelson,	2 wells in use.
Richards & Hartley,	1 " " "
Pennsylvania Salt Manufacturing Co.,	4 " " "
Godfrey & Clark,	1 " " "
Tarentum Heat and Light Co.,	1 " " "

Borough of Washington.

People's Heat and Light Co.,	2 wells in use.

Beaver county.

Bridgewater Gas Co. from Beaver Co. to Phillipsburg, Rochester, Beaver, &c.,	3 wells in use.

How remarkable the growth of the natural gas interests have been, may be seen by comparing the above with the following table clipped from the *American Manufacturer* of Nov. 12, 1886, which shows how many Natural Gas Companies were contributing to Pittsburgh on the first of that month, and the number and location of the wells supplying the gas:

COMPANY.	Murraysville.	Tarentum.	Hickory.	Cannonsburg.	Total.
Philadelphia,	48	10	. .	. . .	58
Chartiers,	7	. . .	16	. . .	23
Manufacturers,	. . .	. . .	. . .	10	10
Pennsylvania,	. . .	1	. .	7	8
Washington,	. .	. . .	5	. . .	5
People's,	3	. .	. . .	. . .	3
Total,	. . .	. .	. .	.	107

In the above, the Philadelphia Company represents the consolidated interests of the old Fuel Gas Co., Acme Gas Co., Carpenter Natural Gas Co., and Philadelphia-Westinghouse Co. On the 1st of January, 1885, these companies were piping gas from 6 wells in the Murraysville field and 5 in the Lyons Run field. That is, from 11 wells located in what is now called the Murraysville district, where the Philadelphia Company were drawing from 48 wells November 1, 1886.

On a hurried visit to Murraysville early in January the following facts were obtained:

Companies operating on the Murraysville belt.

January 1, 1887.

Philadelphia Company, utilizing gas from	**52**	**wells.**
Chartiers Co. " " "	**12**	"
People's Gas Co. " " "	**8**	"
National Tube Co. " " "	**8**	"
Carnegie Gas Line, " " "	**4**	"
Total number of wells in use	**74**	

There were also, as near as could be ascertained, about 15 wells drilling or preparing to drill.

The belt as now developed is about five and a quarter miles long and one mile wide. The southern end, on the Daum farm, begins to be seriously troubled with salt water. One unproductive well has been drilled there by the Philadelphia Company, and the great Guffey well which was struck about the 1st of August, 1885, and thought to be the largest and most promising one in the field, because correctly located on the anticlinal, is already almost ruined. The wells at Murraysville are reported as still free from water and maintaining high pressures. Several of them have temporarily weakened but were readily restored to their former vigor by sinking the drill a few feet deeper into the rock. The strongest pressure, however, is said to be in the new wells at the northeastern end of the field.

None of the wells at Murraysville have been sunk more than 25 or 30 feet in the gas sand, and its actual thickness is not positively known; but, judging from wells that have been put down on the flanks of the belt, it should be over 100 feet thick. If the whole rock is gas bearing, and old wells can be freshened by being drilled five or ten feet deeper from time to time as occasion requires, an unusually long life to the pool would seem to be assured.

CHAPTER VII.

Well Records, Oil and Gas.

Wilcox & Co., well No. 1.

June, 1881.

Located near the southwest corner of warrant No. 2,723, ("Halsey lands") Sergeant township, McKean county. Owners Wilcox & Co. Specimens presented by D. A. Wray.

Well mouth above ocean in feet, (barometer) 1,860

Spec.				
	Conductor	30′	to	30′=1803
	?	94	to	124=1736
1.	Gray sand, 10′ (fine-grained slaty sandstone) .	10	to	134=1726
	?	46	to	180=1680
2.	Gray sand 18′ (Gray sand, fine, friable, mica, lime,)	18	to	198=1662
	?	10	to	208=1652
3.	Soft white sand, 32,′ (Gray sandy slate, fossils, much lime,)	32	to	240=1620
	?	58	to	298=1562
4.	Light-colored sand, 5′ (Sandstone, gray, friable, micaceous,)	5	to	303=1557
5.	Gray sand, 5′ (Sandstone, gray, friable, micaceous,)	5	to	308=1552
6.	Gray and white sand, 32′ (Limestone, fossils, little sand,)	32′	to	340=1520
	?	830	to	1170= 690
7.	Red slate, (Red sandy slate,)	25	to	1195= 665
	?	15	to	1210= 650
8.	Dark sand, 15, (Dark slate, a little sandy,) . .	10	to	1220= 640
	?	176	to	1396= 464
9.	First sand 22′, (Slaty, gray, fine, micaceous, fossils,)	22	to	1418= 442
	?	10	to	1428= 432
10.	Brown sand, smell of oil, 30′, (SS. brownish-gray, fine, slaty, mica,)	30	to	1458= 402
	?	10	to	1468= 392
11.	Gray and white sand, 30′, (Slaty sandstone and slate, fossils,)	30	to	1498= 362
	?	12	to	1510= 350
12.	Clover-seed rock, 8′, (Slate and a few fine pebbles,)	8	to	1518= 342
	?	62	to	1580= 280

13.	White sand, 10′, (Layers of SS. and slate, light-gray, micaceous,)	10	to 1590	= 270
	?	73	to 1663	= 197
14.	Gray and white sand, 5′, (Limestone and slate, fossils,)	5	to 1668	= +192
	?	241	to 1909	= −49
15.	Brown sand, 34′, (Brown sand, fine, micaceous, 27′ good,)	34	to 1943	= −83

The owners of this well instructed their man in charge to keep a complete set of sand-pumpings from top to bottom. He kept it according to his own ideas of what was needed, and when the well was completed sent in 15 specimens numbered and labeled as given on the left. The wide intervals between the numbers are probably filled with slates and shales. The real descriptions of the specimens are inserted in brackets. As none of the samples show anything better than sandy slates with thin flaggy sand layers, the presumption is that no massive sandstones were found in the well. The oil sand at 1909, is a very fair type of the Bradford oil sand, and probably the true representative of that stratum. It made a very good show of oil, but did not respond to the torpedo as was expected After testing, the well was sold to the National Transit company, who drilled it about 100 feet deeper, obtained an excellent gas well and turned it into their Bradford gas line, to which it is still connected.

Halsey No. 8.

July 1886.

Located in the northwest corner of Warrant No. 2685, (Halsey lands) Sergeant township, McKean county. Owners National Transit Co. (Gas Department) Record compiled from specimens.

Specimen Nos.	Well mouth above ocean in feet	(barometer)			1730
	? Conductor,	40	to	40	1690
1—8	Sandy shale,	40	"	80	1650
9—20	SS. Sub-olean conglomerate, pebbly,	60	"	140	1590
21—30	Sandy shale and sandstone, gray, micaceous,	50	"	190	1540
31—33	Slaty sandstone, gray, micaceous, fossils,	25	"	215	1515
34	Slate and shells,	45	"	260	1470
35—36	SS. fine grained, gray, micaceous,	30	"	290	1440
37—38	Slate,	60	"	350	1380

39	SS. light-gray, fine micaceous (oil show),	17	"	367	1363
	?	83	"	450	1280
40	SS. gray, and slate, fossils, ...	12	"	462	1268
	?	43	"	505	1225
41	SS. gray, micaceous, ...	5	"	510	1220
42—43	Red sandy slate, micaceous, ...	30	"	540	1190
44	Reddish slate, ...	10	"	550	1180
45—46	Red rock, sandy slate, ...	55	"	605	1125
	?	100	"	705	1025
47	SS. dark, friable, micaceous, ...	5	"	710	1020
48	Red, sandy slate, ...	5	"	715	1015
	?	45	"	760	970
49	SS. flaky, greenish-gray, ...	20	"	780	950
50—51	Red slate and dark slate, ...	35	"	815	915
	?	45	"	860	870
52	Slate, micaceous, ...	7	"	867	863
	?	41	"	908	822
53	Slate, sandy, ...	6	"	914	816
	?	59	"	973	757
54	Slate, ...	4	"	977	753
	?	131	"	1108	622
55	Slate and shells, ...	6	"	1114	616
	?	66	"	1180	550
56—57	Slate, sandy, ...	12	"	1192	538
	?	108	"	1300	430
58	Sandy slate and red clay, ...	20	"	1320	410
	?	80	"	1400	330
59	Red clay and dark slate, say, ...	20	"	1420	310
	?	80	"	1500	230
60	Slate and shells, "1st SS."	5	"	1505	225
	?	35	"	1540	190
61	Slate and shells, ...	5	"	1545	185
	?	55	"	1600	130
62	Slate and brown sand, ...	5	"	1605	125
	?	35	"	1640	90
63	Slate, ...	5	"	1645	85
	?	45	"	1690	40
64	Slate and little sand, ...	10	"	1700	+30
	. . . .	30	"	1730	0
65	SS. gray micaceous, ...	20	"	1750	—20
	?	20	"	1770	—40
66	Slate, ...	10	"	1780	—50
	?	40	"	1820	—90
67	Slate and shells, ...	30	"	1850	—120
	?	30	"	1880	—150
68—69	Slate, sand micaceous, ...	40	to	1920	—190
	?	30	"	1950	—220
70—75	Slate, some parts sandy, ...	123	"	2073	—343
76	"3rd Sand," brown, micaceous 3 . .	52	"	2125	—395
77—82	Brown sand like Bradford 29, ...				
83—86	" " flaky, micaceous 20, . . .				
	?	25	"	2150	—420

87	Sandy slate,	5	"	2155	—425
	?	45	"	2200	—470
88—89	"4th or Gas sand," brownish slaty,	10	"	2210	—480
90	"Bottom of 4th sand" slate,	5	"	2215	—485
	?	10	"	2225	—495
91	Slate,	5	"	2230	—500
	?	40	"	2270	—540
92—96	SS. brown, some gray, fine, micaceous,	30	"	2300	—570
97	Sandy slate,	10	"	2310	—580
98—99	Slate,	70	"	2380	—650

Halsey No. 9.

March 1886.

Located on Warrant No. 2684, (Halsey lands) Sergeant township, McKean Co. Owners, National Transit Co. (Gas Department) Record compiled from specimens.

Specimen Nos.	Well mouth above ocean in feet,	(barometer)			1730
	?	1355	to	1355	375
1—6	SS. gray,	30	"	1385	345
7—11	Slate,	25	"	1410	320
12—13	SS. dark,	10	"	1420	310
14—17	Slate,	20	"	1440	290
18—19	SS. pebble shells and slate	10	"	1450	280
20—35	Slate,	85	"	1535	195
36	Shells dark,	5	"	1540	190
37—51	Sandy slate (lower part quite sandy),	80	"	1620	110
52—55	SS. fine, dark; and slate,	20	"	1640	90
56—57	Slate,	10	"	1650	80
58	SS. gray, & dark slate,	5	"	1655	75
59	Slate,	5	"	1660	70
60—64	SS. brown and gray, (little oil at 1665)	17	"	1677	53
65—66	SS. and slate,	8	"	1685	45
67—68	Sandy slate,	10	"	1695	+35
69—79	Slate,	65	"	1760	—30
80—86	SS. brown, gas sand slaty,	42	"	1802	—72

A good gas well.

Morck and Dimick well.

May, 1883.

South west corner Lot No. 210, Sheffield township, Warren Co. Authority Geo. H. Dimick.

Well mouth above ocean in feet, (Dimick,)				1715′
Conductor,	38′	to	38	1677′
SS. soft, rusty, 10′ " hard, white, 18′	28′	to	66′	1649′
Slate,	40′	to	106′	1609′
" with thin layers of sand and shale,	144′	to	250′	1465′

SS. blue, hard, (little salt water,)	40' to 290'	1425'
Soapstone and slate, (cased at 302')	12' to 302'	1413'
Slate, shelly,	45' to 347'	1368'
Red rock,	20' to 367'	1348'
SS. hard, gray,	13' to 380'	1335'
Soapstone,	10' to 390'	1325'
Red rock, slaty,	15' to 405'	1310'
Slate,	5' to 410'	1305'
Red rock,	75' to 485'	1230'
Slate	15' to 500'	1215'
SS. blue, close, 12 " , white, 6	18' to 518'	1197'
Slate,	35' to 553'	1162'
Slate and shells,	47' to 600'	1115'
Red rock, brownish-red,	30' to 630'	1085'
Slate,	45' to 675'	1040'
Red rock,	16' to 691'	1024'
Slate, with dark shells at intervals of 10' to 20'	439' to 1130'	585'
" " " " " " " 2' to 5'	68' to 1198'	517'
SS. dark, flaky,	10' to 1208	507'
Slate,	50' to 1258'	457'
SS. dark-gray, slight smell of fetid gas,	40' to 1298'	417'
Slate,	72' to 1370'	345'
SS. dark, close, 10 " light, flaky, 28	38' to 1408'	307'
Slate, with average of one light colored shell to the screw,	148' to 1556'	159'
SS. dark-gray,	6' to 1562'	153'
Slate, with occasional shells,	73' to 1635'	80'
SS. very dark-gray,	8' to 1643'	72'
Slate, very soft, with two thin shells,	17' to 1660'	55'
SS. reddish, with small pebbles, (gas,)	50' to 1710	+ 5
Slate,	6' to 1716	— 1
SS. reddish, (gas,)	20' to 1736	— 21
Slate,	37' to 1773	— 58
SS. gray, green oil,	5' to 1778'	— 63
Slate, soft,	11' to 1789'	— 74
SS. dark bluish, pebble shell on top,	6' to 1795'	— 80
Slate, shelly,	6' to 1801	— 86
SS. similar to gas sand,	36' to 1837	—122
Shells and slate to bottom,	15' to 1852	—137

A very strong gas well.

Glatzau well.

1883.

N. W. Corner, Lot No. 324, Sheffield township, Warren Co. Deepened by Morck & Dimick. Summer of 1883. Authority Geo. H. Dimick.

Well mouth above ocean in feet (Dimick,)				**1870**
?	**1790**	**to**	**1790**	**+ 80**
Slate and white shells, (every bit "headed")	**69**	**to**	**1859**	**+ 11**
SS. very hard, dark-gray, bottom whitish,	**6**	**to**	**1865**	**+ 5**
Slate and shells. equally divided,	**38**	**to**	**1903**	**— 33**
Slate, dark, some grit	**9**	**to**	**1912**	**— 42**
Slate, black, clean,	**26**	**to**	**1938**	**— 68**
SS. shell, gray,	**3**	**to**	**1941**	**— 71**
Slate, clean, very dark, drilled fine,	**6**	**to**	**1947**	**— 77**
SS. reddish,	**8**	**to**	**1955**	**— 85**
Slate and shells, dark,	**20**	**to**	**1975**	**—105**
SS. reddish, (oil and gas show,)	**27**	**to**	**2002**	**—132**
Slate and shells,	**14**	**to**	**2016**	**—146**

Vandergrift well.

On Lot No. 5102, Forest Co.

Well mouth above ocean in feet, (bar,)				**1750**
?	**450**	**to**	**450**	**1300**
Salt water sand, (nearly enough to drill with,) say	**25**	**to**	**475**	**1275**
?	**325**	**to**	**800**	**950**
Clarion SS. gas, soon exhausted,	**40**	**to**	**840**	**910**
?	**760**	**to**	**1600**	**150**
SS. ("show of oil—good pebble sand "	**40**	**to**	**1640**	**+ 110**
?	**410**	**to**	**2050**	**— 300**
Sand (no show of oil,)	**20**	**to**	**2070**	**— 320**
Stopped in slate at			**?**	

Reno well No. 1.

Dec., 1883.

Tract No. 2735, Howe township, Forest Co. Authority T. J. Kerstetter, manager.

Well mouth above ocean in feet			**?**
Conductor	**38**	**to**	**88**
? (Cased at 375)	**1362**	**to**	**1400**
1st SS. (little gas near the middle,)	**25**	**to**	**1425**
?	**487**	**to**	**1912**
SS. red or gray,	**46**	**to**	**1958**
Coarse black slate,	**7**	**to**	**1965**
SS. oil rock, (estimate J. F. C.)	**20±**	**to**	**1985±**

Well produced 90,077 bbls. in the first twelve months, making 39¼ bbls. the last day. Average 246, $\frac{78}{100}$ bbls. per day.

Vensel well.

On Warrant No. 3179, (subdivision 54) 28 rods from west line, 25¾ rods from south line. Authority J. A. Tomlinson, contractor, interlined with D. J. Thayer's record as given by S. B. Hughes. (Thayer's data marked D. J. T.)

Well mouth above ocean in feet, (leveled by J. Smith,)			1623
? D. J. T.,	170 to	170	1453
SS. "	10 to	180	1443
? "	100 to	280	1343
SS. "	10 to	290	1333
? "	25 to	315	1308
SS. "	20 to	335	1288
? "	355 to	690	933
SS. "	10 to	700	923
Red rock, (First strata given by Tomlinson,)	10 to	710	913
SS. little gas,	10 to	720	903
Red rock and streaks of sand, (310′ Tomlinson,)	70 to	790	833
SS. gas "Clarion sand" D. J. T.,	10 to	800	823
Red do. continued,	230 to	1030	593
SS.	16 to	1046	+577
Soft drilling, some red rock	634 to	1680	— 57
SS. sharp; gray, gas at 1800, (D. J. T. says 132,)	130 to	1810	—187
?	140 to	1950	—327
SS. gray, (D. J. T. says 18′ SS. chocolate color, mixed with slate, oil show)	15 to	1965	—342
? to bottom, (D. J. T. says 2233′ deep,)	265 to	2230	—607

No oil. Gas enough at 1800 to furnish fuel for completing the well.

Grace well.

1882-83

On Walters farm, S. E. corner of Warrant No. 3820, (Hughes says 3819) Forest Co. Near Clarion Co. line. Authority, S. B. Hughes, ("from drillers note book.")

Well mouth above ocean in feet,			?
Conductor,	10 to	10	=
?	120 to	130	=
Mountain sand,	70 to	200	=
Slate,	60 to	260	=
SS. gray,	40 to	300	=
Sand and slate,	65 to	365	=
? (Cased at 371,)	75 to	440	=
Slate and shells,	60 to	500	=
Red rock,	60 to	560	=
Slate and shells,	60 to	620	=
Red rock,	40 to	660	=
Shells, "mostly,"	30 to	690	=
Slate and shells,	185 to	875	=
SS. "gas sand,"	30 to	905	=
Slate,	30 to	935	=

SS. "Salt water sand,"	30 to 965	=
Slate and shells,	735 to 1700	=
SS. gray and flaky,	70 to 1770	=
Slate,	285 to 2055	=

Best well No. 1.

April, 1885.

On W. Hoop farm, Warrant No. 3726, Corydon township, Warren Co. Half a mile N. of Sugar Run and at the foot of the hills say ¼ mile E. of the Allegheny river.

Record as given to Mr. Best by contractor.

Well mouth above ocean in feet, say		1250
? (Cased at 169',)	440 to 440	810
Hard shells and sand,	50 to 490	760
Soft slate,	125 to 615	635
Hard shells and sand,	25 to 640	610
Slate,	25 to 665	585
Shells and slate,	45 to 710	540
Slate—to bottom,	10 to 720	530

Hoodoo well.

1883.

S. W. corner of Warrant No. 3668, Jenks township, Forest Co., at junction of Wolf creek with Spring creek. N. of Wolf and E. of Spring creek. Authority P. C. Boyle, J. C. McMullen and S. B. Hughes.

Well mouth above ocean in feet, (barometer,)		1430
Drive pipe,	40 to 40	1390
? (cased at 450,)	547 to 587	843
"Clarion sand," gas and salt water,	18 to 605	+ 825
?	870 to 1475	— 45
"Cherry Grove sand." white pebbles: amber oil: 3 bls. per day,	17 to 1492	— 62
?	178 to 1670	— 240
Sand,	39 to 1709	— 279
?	26 to 1735	— 305
Red sand, resembling Cooper stray,	40 to 1775	— 345
Hard drilling,	125 to 1900	— 470
Shells and black slate,	235 to 2135	— 705
Red sand, one screw,	5 to 2140	— 710
?	95 to 2235	— 805
"Bradford sand," no show of oil,	25 to 2260	— 830

Total depth 2260.

Murphy well.

Feb. 1883.

On Warrant No. 3800, Jenks township, Forest county, 163 rods from E. line and 27½ rods from N. line. Authority H. Landsrath, M. Murphy and S. B. Hughes.

Well mouth above ocean in feet, (bar.,)		1785
?	25 to 25	1760
Show of coal at	— 25	1760
?	25 to 50	1735
Show of coal at	— 50	1735
?	10 to 60	1725
Show of coal at	— 60	1725
? (Cased at 568: first red at 770,)	710 to 770	1015
Red rock and hard shells, about	200 to 970	815
?	116 to 1086	699
SS. hard gray; in red rock,	12 to 1098	687
? ("Drillings chocolate at 1400',")	302 to 1400	+ 385
?	620 to 2020	— 235
"Sheffield sand," show of oil	20 to 2040	— 255
?	45 to 2085	— 300
Sand,	28 to 2113	— 328
?	37 to 2150	— 365
"Solid sand, little gas, small oil show,"	50 to 2200	— 415
?	160 to 2360	— 575
Sand, poor,	25 to 2385	— 600
Slate to bottom of well,	120 to 2505	— 720

This well was a total failure both as to gas and oil.

Cornwall well, No. 2.

June, 1883.

Warrant No. 5134, Kingsley township, Forest Co. Authority S. B. Hughes. (Notes in brackets given by Mr. Keeler, who was in charge of the well while drilling; from memory at Macksburg, O., Jan. 16, 1884.)

Well mouth above ocean in feet (barometer,)		1610
? (Conductor 23'. Salt water sand at 400= Red rock under)	750 to 750	860
Clarion sand, some gas, soon exhausted,	30 to 780	830
Soft drilling, (Clarion sand 900' to 915',)	320 to 1100	510
1st SS.	100 to 1200	410
Shelly	190 to 1390	220
2nd SS. white	50 to 1440	+ 170
Soft drilling,	240 to 1680	— 70
3rd SS. Balltown sand; gas and oil show, about	20 to 1700	— 90
(SS. 1675 to 1685. Show of amber oil,)		

Soft drilling,	200 to 1900	— 290
Very hard shells,	28 to 1928	— 318
SS. white, pebbly, coarse,	25 to 1953	— 343
(Cooper stray, 1950 to 1990. Brown sand, oil show)		
(Cooper sand, 1990 to 1995; Gray sand)		
(Slate and shells, 1995 to 2075. End of first drilling,)		
Shelly	147 to 2100	— 490
SS. light gray—show of oil	30 to 2130	— 520
Soft drilling, about	70 to 2200	— 590
Total depth about 2200.		

Well No. 1, near by, struck sand at 1755'. Both unproductive.

Crull, Campbell & Co.

Spring of 1886.

Near Center of Warrant, No. 3190, Jenks Township, Forest Co. About ¾ mile from Gilfoyl station on Pittsburg and Western R. R. Authority, Mr. Mooney.

Well mouth above ocean in feet,		1577
?	820 to 820	757
SS. shelly (good gas at 848,)	35 to 855	722
Good drilling,	25 to 880	697
"First sand" thickness not given, at	880	697
Good drilling,	488 to 1368	209
Red sand at	1368	+ 209
?	232 to 1600	— 23
SS. gray ?	20 to 1620	— 43
?	215 to 1835	— 258
SS. "Balltown" (fair show of oil,)	45 to 1880	— 303
?	285 to 2165	— 588
SS. fair sand, brownish, oil show, 40' SS. mixed with slate, 20 } "Bradford,".	60 to 2225	— 648
Slate and shells, good drilling,	125 to 2350	— 773

Tools struck and well abandoned at 2350 feet.

Windfall well No. 1.

May 1886.

Drilled on east end of Warrant No. 3163, 162 rods from the north line and 15 rods from the east line of warrant; (in the Windfall on Millstone creek,) Jenks Tp. Forest Co. by the Tarentum Oil Co.

Authority J. M. Bonham—Drillers record.

Well mouth above ocean in feet	(Jos. Smith)			1479'
Drive pipe	55'	to	55'	1424'
Slate,	10'	to	65'	1414'
Sand, coarse,	6'	to	71'	1408'
Red rock,	9'	to	80'	1399'
Slate,	10'	to	90'	1389'
Sand, coarse, hard,	30'	to	120'	1359'
Slate,	25'	to	145'	1334'
SS.	105'	to	250'	1229'
Slate & shells,	30'	to	280'	1199'
SS. solid,	50'	to	330'	1149'
Slate,	70'	to	400'	1079'
Shells and slate,	15'	to	415'	1064'
Slate, (salt water at 465; cased at 470,)	155'	to	570'	909'
SS. (Called "Clarion 2nd,")	30'	to	600'	879'
Slate and shells,	60'	to	660'	819'
Red rock,	30'	to	690'	789'
Slate and shells,	20'	to	710'	769'
Red rock,	80'	to	790'	689'
SS. firm, hard, gas, ("Clarion 3rd,")	20'	to	810'	669'
Black slate,	5'	to	815'	664'
Red rock,	10	to	825'	654'
Slate,	5'	to	830'	649'
Red rock,	45'	to	875'	604'
SS.	10'	to	885'	594'
SS., slate & streaks of red rock,	65'	to	950'	529'
SS., soft, blue,	40'	to	990'	489'
? ———	50'	to	1040'	439'
Red rock,	20'	to	1060'	419'
Shells and slate,	115'	to	1175'	304'
Red rock,	10'	to	1185'	294'
Slate & shells,	125'	to	1310'	169'
Red rock,	15'	to	1325'	154'
Slate & shells,	145'	to	1470'	+ 9'
Slate, white,	50'	to	1520'	— 41'
Slate & shells, very hard,	40'	to	1560'	— 81'
" " soft,	278'	to	1838'	—359'
SS. soft, gray,	10'	to	1848'	—369'
Slate,	42'	to	1890'	—411'
Slate & shells,	110'	to	2000'	—521'
Slate,	84'	to	2084'	—605'
Red sand,	6'	to	2090'	—611'
Slate & shells,	310'	to	2400'	—921'
SS. red, (smell of oil no gas),	10'	to	2410'	—931'
Slate,	170'	to	2580'	—1101'
Soft shell; good drilling to bottom,	50½'	to	2630½'	—1151½'

Unproductive.

Whitney well.

Aug. 1883.

On Stewart and Irwin tract Tubbs run, Tionesta township, Forest Co. Record kept by the drillers, and given by D. W. Clark, who had charge of the well.

Well mouth 596.51′ above R. R. Station Tionesta ; spirit levels.

Well Mouth above ocean in feet,	(1060+596)	1656′
?	600′ to 600′	1056′
Slate & shale,	150′ to 750′	906′
Red rock—sandy,	50′ to 800′	856′
Slate,	10′ to 810′	846′
Red rock, sandy,	20′ to 830′	826′
Slate,	20′ to 850′	806′
Shale & slate,	50′ to 900′	756′
SS., white,	15′ to 915′	741
Slate and shale,	35′ to 950′	706
SS. hard, with some pebbles,	15′ to 965′	691′
SS. good show of oil,	25′ to 990′	666′
Slate & shale,	60′ to 1050′	606′
SS. coarse,	30′ to 1080′	576′
Slate & shale,	20′ to 1100′	556′
Red rock, sandy,	80′ to 1180′	476′
Slate & shales,	120′ to 1300′	356′
Red rock,	75′ to 1375′	281′
Slate & shale,	55′ to 1430′	226′
SS. white,	15′ to 1445′	211′
Red rock,	45′ to 1490′	166′
SS.	20′ to 1510′	146
Slate & shales,	105′ to 1615′	41
SS. hard, some gas,	12′ to 1627′	+ 29
Slate & shales,	31′ to 1658′	— 2′
SS. hard,	11′ to 1669′	— 13′
Slate & shales,	41′ to 1710′	— 54
SS. brown, (pebbles & some lively gas,)	3′ to 1713′	— 57′
Slate—soft with very few shells,	52′ to 1765	—109′
SS. dark,	13′ to 1778′	—122′
Slate & shells,	22′ to 1800′	—144
Slate and hard shells,	30′ to 1830	—174′
Hard shells,	10′ to 1840′	—184′
SS. gray, with some red sand,	15′ to 1855′	—199′
SS. reddish—very hard,	5′ to 1860′	—204′
SS. gray, with white pebbles,	10′ to 1870′	—214′
Slate & shells,	15′ to 1885	—229′
SS. hard,	5′ to 1890′	—234′
SS. gray,	10′ to 1900′	—244′
Sand and slate,	10′ to 1910′	—254′
Slate & shells—soft drilling,	70′ to 1980	—324′
SS.	15′ to 1995′	—339′
Slate,	75′ to 2070′	—414′
SS.	10′ to 2080′	—424
Slate & shells,	20′ to 2100′	—444′
Slate,	10′ to 2110′	—454′

SS.	8' to 2118'	—462'
Slate,	12' to 2130'	—474'
SS. dark,	10' to 2140	—484'
Slate,	20' to 2160	—504'
Sand shell,	5' to 2165'	—509
Slate to bottom,	12' to 2177	—521

Unproductive.

Roy and Archer well, No. 3.

Oct. 1881.

On Warrant No. 3788, Highland Township, Elk county. Near the west end and north of center of Warrant. Authority Geo. L. Benton.

Well mouth above ocean in feet, (barometer,)		1900
Conductor,	15 to 15	1885
? (Cased at 475,)	460 to 475	1425
Slate,	25 to 500	1400
Red sand and slate,	200 to 700	1200
?	100 to 800	1100
Red sandstone,	100 to 900	1000
?	700 to 1600	300
1st SS. red in center, (gas,)	75 to 1675	225
?	125 to 1800	100
Red rock,	20 to 1820	+ 80
?	278 to 2098	— 198
SS. coffee color, little gas, good show oil,	15 to 2113	— 213
Slate—mostly,	171 to 2284	— 384
3rd SS. no oil but heavy gas.	53 to 2337	— 437

A large and lasting gas well.

Hunter Run well.

Oct. 1884.

Warrant No. 3663, Highland township, Elk Co. Authority, driller, per Mr. J. Johnson.

Well mouth above ocean in feet,		?
Conductor,	22 to 22	
? (Cased at 327,)	488 to 510	
Red rock,	40 to 550	
SS. gray; salt water,	15 to 565	
Red slate,	235 to 800	
?	1070 to 1870	
Gas sand,	7+ to 1877	
?	273 to 2150	
Gray SS. (sandy shells,)	40 to 2190	
?	68 to 2258	
Chocolate SS. to bottom,	44 to 2302	

Well torpedoed in the lower sand. Pumped about a week and then abandoned. Said to have produced from 3 to 5 barrels per day.

Emery well.

1882?

On Coon run, Warrant No. 3777, Highland township, Elk Co. Authority L. Emery, Jr., Dec. 1, 1883.

Well mouth obove ocean in feet, (barometer,)		1725
?	400 to 400	1325
Red rock,	300 to 700	1025
?	740 to 1440	285
1st SS.	25 to 1465	260
?	185 to 1650	75
Red—sandy,	15 to 1665	+ 60
?	75 to 1740	— 15
2nd SS. thickness not given—say	20 to 1760	— 35
? ("Gas sand 10′ above 3rd sand,")	323 to 2083	— 358
3rd SS. thickness not given—say	17 to 2100	— 375
? to bottom,	100 to 2200	— 475

S. B. Hughes says he was told "this well struck sand at 2190′. There was 30′ or 40′ of brown sand and a fair show of oil, and it would have made a small well."

Hallock and Johnson well.

1883?

Warrant No. 3653 Highland township, Elk Co. Authority, Mr. J. Johnson.

Well mouth above ocean in feet, (barometer,)		1860
?	1890 to 1890	— 30
1st. SS. like Bradford, but not so dark, (gas,)	20 to 1910	— 50
?	205 to 2115	— 255
2nd. SS. like Bradford, (heavy gas,)	30 to 2145	— 285
?	255 to 2400	— 540
3rd. SS. (" Bradford sand no show of oil,") gas,	48 to 2448	— 588

Very strong gas at 2145′. Had to let water down in the bailer. No oil. Abandoned.

Johnson & Gilmore well.

July, 1884.

In N. E. corner of S. E. quarter of Warrant No. 3784, Highland township, Elk Co. Authority, S. B. Hughes.

Well mouth above ocean in feet, (barometer,)			1990
? (Cased at 384,)	580 to 580		1410
Red rock,	270 to 850		1140
Slate, blue: and hard sand shells,	150 to 1000		990
Slate and shells, hard,	320 to 1320		670
Pebble shell gas,	1320		670
Slate and shells, hard,	25 to 1345		645
Red rock,	10 to 1355		635
Slate and shells,	245 to 1600		390
Sand, pebbly,	5 to 1605		385
Slate and shells, hard,	65 to 1670		320
Sand, white and pebbly, gas,	20 to 1690		300
Sand and slate—mostly sand, hard,	95 to 1785	+	205
Sand and shells,	340 to 2125	÷	135
Slate, a little sandy,	65 to 2190	—	200
Slate, shell occasionally,	65 to 2255	—	265
SS. brownish-gray, little gas,	20 to 2275	—	285
Slate—shelly,	53 to 2328	—	338
SS. quite brown,	45±to 2373	—	383

"Large flow of gas from near the top of last sand, which increased some afterwards—could not pour water in for drilling. Had to let it down in the bailer. Drilled probably 40 or 50 feet in the sand. No show of oil and well abandoned."

Crane Run well.

On Warrant No. 3773, Highland township, Elk Co. Authority S. B. Hughes.

Well mouth above ocean in feet, (barometer,)			1490
?	2090 to 2090	—	600
Brown sand,	5 to 2095	—	605

Unproductive.

Boughton well.

1882–83.

On Warrant No. 3251, Jones township, Elk Co. Authority, S. B. Hughes; record obtained from contractor.

Well mouth above ocean in feet, (barometer,)			1650
? (Gas at 1000,)	1680 to 1680	—	30
SS. red thickness unknown—say	20 to 1700	—	50
?	450 to 2150	—	500
SS. red,	35 to 2185	—	535
SS. gray—no slate in it,	25 to 2210	—	560
Slate,	80 to 2290	—	640
SS.	15 to 2305	—	655
? to bottom,	15 to 2320	—	670

No show of oil.

Johnsonburg well.

1877 ?

On Warrant No. 3287, near Johnsonburg R. R. Station, Ridgway township, Elk Co. Record and sand pumpings furnished by Wm. Kaney, contractor. Number of the specimens on the left.

Spec.						
	Well mouth above ocean in feet about					1450
	Conductor, (Drive, Pipe,)	43	to	43		1407
1.	SS. hard	42	to	85		1365
2.	Slate, gray,	30	to	115		1335
3.	SS. gray,	32	to	147		1303
4.	Slate,	31	to	178		1272
5.	SS. black,	20	to	198		1252
	Slate, red,	2	to	200		1250
	Sand and slate,	50	to	250		1200
	Slate, gray,	60	to	310		1140
6.	SS. and slate, red,	115	to	425		1025
7.	SS. gray,	15	to	440		1010
8.	Slate, red,	25	to	465		985
9.	Slate, gray,	10	to	475		975
10.	Slate, red, (Cased at 494,)	157	to	632		818
11.	Slate, gray,	18	to	650		800
	Sand, red, (Gas at 660′,)	38	to	688		762
	Slate, gray,	57	to	745		705
12.	SS. gray,	25	to	770		680
13.	Slate, gray,	328	to	1098		352
	" red,	8	to	1106		344
	" gray,	28	to	1134		316
	SS. gray,	5	to	1139		311
14.	Slate, red,	6	to	1145		305
	" gray,	51	to	1196		254
	SS., "	6	to	1202		248
	Slate and shells, gray,	168	to	1370		80
	SS. gray,	40	to	1410		40
15.	Slate and shells, gray,	28	to	1438	+	12
16.	SS. gray,	15	to	1453	—	3
	Slate, gray,	25	to	1478	—	28
17.	SS. gray,	12	to	1490	—	40
18.	Slate, gray,	38	to	1528	—	78
19.	Sand and shells gray,	30	to	1558	—	108
20.	Slate and shells, gray,	82	to	1640	—	190
21.	SS. gray,	20	to	1660	—	210
22, 23.	SS. Brown, (Gas at 1663 and 1678,)	32	to	1692	—	242
	Slate, light color,	68	to	1760	—	310
	Slate and hard shells,	35	to	1795	—	345
	SS.	25	to	1820	—	370
	Slate, light color,	80	to	1900	—	450
24.	SS. gray,	58	to	1958	—	508

	25. Slate, gray,	70 to 2028	— 578
26, 27,	28. SS. (Salt water at 2030,)	22 to 2050	— 600
	29. Slate,	336 to 2386	— 936
	30. SS. gray,	25 to 2411	— 961
	31. Shells and slate, hard,	41 to 2452	— 1002
	32. Slate, to bottom,	58 to 2510	— 1060

A large gas well. Gas allowed to go to waste for several years, but now being utilized.

Grant & Horton well.

1880.

On small stream 100 rods above the tannery at Ridgway, Elk Co. Authority, Mr. Grant.

Well mouth above ocean in feet, (bar.,)			1420
Drive pipe,	33 to	33	1387
? (Cased at about 200) some red,	857 to	890	530
SS. (gas "quite a little" at 905,)	15 to	905	515
?	15 to	920	+500
Red rock, principally,	533 to	1453	— 33
SS.	20 to	1473	— 53
Shales and sand shells blue and green,	347 to	1820	—400

This well was put deeper in 1883 but not materially improved.

Well No. 18 Marshall Farm.

May 1885.

Located on Marshall Farm, Penn township, Butler Co. about 5 miles S. W. of the town of Butler; in the Thorn Creek district .

Owners, Fisher Oil Co. Record furnished by Supt. P. Birchfield.

?	210 to	210
Limestone,	26 to	236
?	194 to	430
Mt. SS.,	220 to	650
?	150 to	800
1st SS.,	40 to	840
?	205 to	1045
Gas SS., (Salt water at 1075,)	45 to	1090
?	95 to	1185
100′ SS.,	97 to	1282
?	73 to	1355
30′ SS.,	25 to	1380
?	20 to	1400

Blue Monday,	**25 to 1425**
?	**35 to 1460**
Boulder,	**15 to 1475**
?	**25 to 1500**
3d and 4th SS.,	**42 to 1542**
?	**13 to 1555**

Well No. 16 Marshall Farm.

April 1885.

Located on Marshall farm, Penn township, Butler Co. about 5 miles S. W. of the town of Butler; in the Thorn Creek district. Owners, The Fisher Oil Co. Record furnished by Supt. P. Birchfield.

?	**350 to 350**
Limestone,	**15 to 365**
?	**175 to 540**
Mt. SS.,	**150 to 690**
?	**160 to 850**
1st. SS.,	**50 to 900**
?	**235 to 1135**
Gas Sand, (Salt water 1155,)	**40 to 1175**
?	**100 to 1275**
100′ SS.,	**100 to 1375**
?	**60 to 1435**
30′ SS.,	**30 to 1465**
?	**25 to 1490**
Blue Monday,	**25 to 1515**
?	**15 to 1530**
Boulder,	**20 to 1550**
?	**30 to 1580**
3rd and 4th SS.,	**50 to 1630**
?	**18 to 1648**

Well No. 19, Wallace Farm.

March, 1885.

Located on Wallace farm, Penn township, Butler Co., about 4 miles S. W. of the town of Butler. In the Thorn creek district. Owners Fisher Oil Co. Record furnished by Supt. P. Birchfield.

?	**487 to 487**
Limestone,	**28 to 515**
?	**215 to 730**
Mt. SS.	**225 to 955**
?	**57 to 1012**
1st SS.	**40 to 1052**
?	**211 to 1263**

Gas sand,	75	to	1338
?	92	to	1430
100′ sand,	105	to	1535
?	65	to	1600
30′ sand,	29	to	1629
?	31	to	1660
Blue Monday,	27	to	1687
?	18	to	1705
Boulder,	8	to	1713
?	27	to	1740
3rd SS. and 4th,	32	to	1772.

Noel well No. 3.

July, 1885.

On the Noel farm, Thorn creek, Penn township, Butler county. Owners, Stone and Clark. Authority, S. B. Hughes.

Well mouth above ocean in feet,					
?			455	to	455
Limestone,			23	"	478
?			47	"	525
60′ rock,			67	"	592
? (612′ of 5⅝ casing,)			105	"	697
40′ rock,			44	"	741
?			204	"	945
1st SS. estimated,			20	"	965
?			495	"	1460
100′ sand, (salt water,)			90	"	1550
? (Cased with 4¼ at 1560,)			78	"	1628
30′ SS.			29	"	1657
?			24	"	1681
Blue Monday, say			10	"	1691
?			82	"	1773
SS. pebbles,	11	Oil sand,	52.9	"	1825.9
Slate,	3				
SS. gray and close,	17				
" fine sand and pebbles,	14.6				
" gray and poor,	7.3				

A good well; pumping 25 bbls. Nov. '85.

Balph well.

July, 1885.

On the Balph farm, 16½° W. from St. Joe, in Oakland township, Butler county. Authority, S. B. Hughes.

?	237	to	237
Lime,	26	"	263
? (Cased in slate 445,)	917	"	1180
100 foot sand,	105	"	1285
? (4½ casing 1290,)	75	"	1360
30′ SS. (thin) say	15	"	1375
?	15	"	1390
Boulder, thin,	10	"	1400
?	43.6	"	1443.6
3rd SS.	6.6	"	1450
?	45.7	"	1495.7
4th SS. good, pebbly,	7.1	"	1502.8
Gray and broken, "bastard sand,"	11.2	"	1513.10
Slate to bottom,	63.2	"	1577

Dry—little gas.

Pugh Farm well.

Oct. 1885.

Butler Co. Authority, S. B. Hughes.

Well mouth above ocean in feet,			
?	113	to	113
Limestone, estimated,	12	"	125
? (Cased at 410,)	1022	"	1147
"30 ft. sand" white, close, show of amber oil,	41	"	1188
Slate,	5	"	1193
Red rock,	5	"	1198
Slate and shells,	20	"	1218
SS. gray,	5	"	1223
Slate,	5	"	1228
Boulder, grayish solid,	20	"	1248
Slate, little shelly,	22	"	1270
SS.	8	"	1278
Slate,	50	"	1328
SS. white pebbly, strong gas at 1335, and show of green oil,	22½	"	1350½
Slate, soft,	69½	"	1420

Reiber Gas well.

1885?

On Sarah McCandless farm near Butler, Butler Co. Authority Mr. Reiber.

Well mouth above ocean in feet,	?		
?	942	to	942
"Gas sand," (strong gas,)	15	"	957
?	113	"	1070
"100 ft. Rock," (Salt water at 1078,)	152	"	1222

?	14	"	1236
"30 ft. rock,"	39	"	1275
?	35	"	1310
"Blue Monday" at,			1310
?	30	"	1340
"Boulder" at,			1340
?	50	"	1390
"4th sand,"	15	"	1405
Slate,	95	"	1500

Two screws of slate in the 100 ft. rock. The contractor says most of the gas comes from the gas sand; but the well flowed and "cleaned itself" when the 4th sand was struck—the hole being nearly full of salt water—and has continued to flow ever since, producing about 300 barrels of salt water per day, a large quantity of gas.

Butler Gas Co. No. 1.

Sarah McCandless farm near Butler, Butler Co. Authority ——

Well mouth above ocean in feet,			?
? (700′ of 5⅝ casing,)	1527	to	1527
"30 ft. rock" Cased at the top with 4¼ at,			1527
?	151	"	1678
4th sand, (strong gas at 1684,)	30	"	1708
? to bottom,	5	"	1713

Phillips well No. 1.

Leiber farm, Butler township Butler Co. Authority ——:

Well mouth above ocean in feet,			?
?	205	to	205
Limestone at,			205
? (Cased at 454,)	800	"	1005
Gas sand—(very strong gas,)	20	"	1025
?	118	"	1143
"100 ft. rock," (Salt water 1168,)	110	"	1253
?	204	"	1457
4th Sand, (no gas,)	4	"	1461
?	63	"	1524

Associated Producers well No. 12.

Jno. Q. Kennedy farm, Penn township Butler Co. Authority ——.

Well mouth above ocean in feet,			?
?	295	to	295
? (including Gas sand, no gas) Cased at 525,	955	"	1250

100 ft. rock (salt water at 1277,)	100	"	1350
?	215	"	1565
4th Sand,	55	"	1620
?	14	"	1634

Best production 1500 barrels per day.

Craig well No. 1.

1886.

On the Rivers farm, near the center of Winfield township, Butler Co. Authority F. A. Conkle.

Well mouth above ocean in feet,			
?	296	to	296
Limestone,	15	"	311
? (Cased at 485,)	335	"	646
Mountain sand,	164	"	810
?	69	"	879
"1st Sand,"	95	"	974
?	366	"	1340
"100 ft. rock,"	65	"	1405
?	23	"	1428
"30 ft. rock,"	25	"	1453
?	22	"	1475
"Blue Monday,"	17	"	1492
?	8	"	1500
Boulder,	28	"	1528
?	56	"	1584
"3rd SS. poor,	16	"	1600
?	10	"	1610
"4th SS."	25	"	1635
Slate to bottom,	50	"	1685

No gas, oil or water.

Jefferson Center well.

1886.

Belonging to Extension Oil Company and located on the Welch farm, near Jefferson Center, Jefferson township, Butler county.

Authority, F. A. Conkle.

Well mouth above ocean in feet,			
?	340	to	340
Limestone, say,	15	"	355
? (cased at 405′ and dry,)	850	"	1205
Gas sand, (gas at 1210; oil show at 1230,) about,	35	"	1240
?	108	"	1348

100 foot rock,	105	"	1453
?	27	"	1480
30 foot rock,	60	"	1540
?	40	"	1580
Blue Monday, say	15	"	1595
?	21	"	1616
3rd Sand,	34	"	1650
Slate,	13	"	1663
4th Sand,	10	"	1673
Slate,	38	"	1711
5th Sand, coarse, pebbly,	5	"	1716
Slate,	16	"	1732

Oil in 5th sand; darker than the usual Butler county oil. Well packed and flowing 3 barrels per day of exceedingly lively oil.

Millinger well No. 1.

1885.

On the Millinger farm near the east line of Slippery Rock township Butler Co.; about a mile and a half east of Oneida Station on the Shenango & Allegheny R. R. Owners, Columbia Oil Co. Authority, D. McGrew.

Well mouth above ocean in feet,			
?	185	to	185
Limestone, (Ferriferous,)	20	"	205
?	921	"	1126
"100 ft. sand," (gas at 1126' Salt water at 1,156',)	128	"	1254
Slate,	51	"	1305
Blue Monday,	12	"	1317
Slate,	28	"	1345
Boulder,	25	"	1370
Slate,	14	"	1384
3rd sand,	19	"	1403
Slate,	43	"	1446
SS. pebbly,	12	"	1458
Slate,	1	"	1459
SS. white,	5	"	1464
Slate,	1	"	1465
SS. black,	8	"	1473
Slate, black,	17	"	1490
SS. oil show—none above this,	7	"	1497
Slate, soft,	14	"	1511
" and shells,	221	"	1732
" soft,	75	"	1807
" and shells,	133	"	1940
SS. brownish-red, fine,	25	"	1965
Slate,	50	"	2015

SS. gray, fine,	30	"	2045
Shells,	50	"	2095
Slate,	40	"	2135

Hunter & Cumming's well No. 1.

Jacob Reott farm, Clearfield township Butler Co. Authority ——————

Well mouth above ocean in feet,			?
?	444	to	444
Limestone at,			444
? (Cased at 645,)	201	"	645
Mountain sand—thickness not given, (Salt water at 100) say,	200	"	845
?	420	"	1265
Gas sand, little gas,	65	"	1330
?	131	"	1461
"100 ft. rock," (Salt water at 1479,)	99	"	1560
?	210	"	1770
4th Sand.	20	"	1790
?	5	"	1795

Small oil well, but very little gas.

McJunkin & Co. No. 1.

On Jno. Dean farm, Butler township, Butler Co. Authority.———

Well mouth above ocean in feet,			?
?	322	to	322
Limestone at,			322
? (including Gas sand, no gas,) Cased at 570,	963	"	1285
"100 ft. Rock," (salt water at 1289,)	90	"	1375
? (Cased with 4¼ to 1375,)	74	"	1449
"30 ft. Rock," (some salt water,)	20	"	1469
?	131	"	1600
4th Sand, strong gas near bottom,	24	"	1624
?	13	"	1637

Four wells drilled by the Mahoning Natural Gas Co. of Youngstown near Harrisville, Butler Co. in 1885 & 1886. Authority, A. B. Cornell.

Well No. 1.

On Thomson farm, a short distance southeast of Harrisville, Mercer township.

Well mouth above ocean in feet, (barometer,)				1280
Drive pipe,	12	to	12	1268
Slate,	108	"	120	1160

SS. white,	60	"	180	1100
Slate,	40	"	220	1060
Mountain sand,	270	"	490	790
Slate, black,	35	"	525	755
Slate and shells,	275	"	800	480
Red rock,	70	"	870	410
Gas Sand, (Venango 1st sand)	10	"	880	400

A very fair gas well.

Well No. 2.

On the Beatty farm, about 3 miles southwest of Harrisville, Mercer township.

Well mouth above ocean in feet, (barometer,)				1300
Drive pipe,	55	to	55	1245
Slate,	10	"	65	1235
SS.	15	"	80	1220
Coal blossom,	3	"	83	1217
Slate, black,	90	"	173	1127
Mountain sand,	300	"	473	827
Slate, black,	275	"	748	552
SS.	16	"	764	536
Slate,	50	"	814	486
Red rock,	125	"	939	361
Gas sand, (Venango 1st Sand,)	8	"	947	353
Slate and shells,	280	"	1227	73
SS. shelly, (Venango 3rd sand,)	15	"	1242	+ 58
Slate,	125	"	1367	— 67

Well No. 3.

On the Bigham farm, on the line between Mercer and Slippery Rock townships, about 80 rods west of the road leading from Harrisville to Adams Corners.

Well mouth above ocean in feet,			
Drive pipe,	32	to	32
Sand and shell,	40	to	72
Limestone,	25	to	97
Slate,	12	to	109
SS.	15	to	124
Coal blossom,	4	to	128
Slate, black,	90	to	218
Mountain sand,	300	to	518
Slate, black,	275	to	793
SS.	16	to	809
Slate and shells,	40	to	849
Red rock,	91	to	940
Gas sand, not through, (Venango 1st sand,)	8	to	948

Well No. 4.

On the Black farm, Marion township, about 150 rods north of the old McMurray well and on the west bank of McMurray's Run.

Well month above ocean in feet,	
Drive pipe,	**45 to 45**
Mountain sand,	**300 to 345**
Slate, black,	**265 to 610**
SS.	**18 to 628**
Slate and shells,	**50 to 678**
Red rock,	**80 to 758**
Gas sand, (Venango 1st sand,)	**7 to 765**

Bovard well.

1886.

Located a quarter of a mile west of Wicks station on the Shenango and Allegheny R. R., Mercer township, Butler Co. Authority, A. B. Cornell.

Well mouth above ocean in feet,	
Drive pipe,	**63 to 63**
Limestone,	**20 to 63**
SS.	**15 to 98**
Coal blossom,	**3 to 101**
Slate, black,	**75 to 176**
Mountain sand,	**280 to 456**
Slate,	**262 to 718**
SS.	**16 to 734**
Slate,	**50 to 784**
Red rock,	**120 to 904**
Gas sand, (Venango 1st sand,	**8 to 912**

CHAPTER VIII.

Well Records in Westmoreland County.

Boulton and Doubleday No. 1.

March, 1883.

On Henry Remaley's farm at Murraysville, (about 800′ westerly from Haymaker gas well,) Franklin township, Westmoreland Co. Authority, Mr. Doubleday.

Well mouth above ocean in feet, (barometer,)					925
Conductor,	17	to	17	=	908
SS.	44	to	61		864
Coal,	1	to	62		863
Slate,	5	to	67		858
Coal,	4	to	71		854
Slate,	77	to	148		777
Coal, (slate in center,)	14	to	162		763
Slate,	50	to	212		713
Sand,	25	to	237		688
Slate,	20	to	257		668
Slate and shells,	40	to	297		628
SS.	80	to	377		548
Slate and shells,	25	to	402		523
SS.	100	to	502		423
Slate,	5	to	507		418
Red rock,	20	to	527		398
Slate and shells,	20	to	547		378
SS.	155	to	702		223
Slate, black,	70	to	772		153
SS.	80	to	852		73
Slate and shells,	10	to	862	+	63
SS.	100	to	962	—	37
Slate and shells,	20	to	982	—	57
Slate,	20	to	1002	—	77
SS.	100	to	1102	—	177
Sand and slate,	115	to	1217	—	292
SS.	30	to	1247	—	322
Slate,	70	to	1317	—	392
SS. gas sand, not through,	9	to	1326	—	401

Considerable flow of gas, but probably the smallest well in the Murraysville gas pool. [Drilled deeper in 1886 and a large flow of gas obtained.]

Murray well, No. 2.

1886.

Located at Murraysville and owned by the Philadelphia Natural Gas Co., of Pittsburgh. From specimens preserved by the drillers for the company.

Spec. Nos.				
	Well mouth above ocean in feet,			
	Conductor,	19	to	19
1.	Sandy shale,	21	"	40
2.	SS. white, friable, massive,	55	"	95
3.	Slate, dark,	55	"	150
4.	Dark limestone,	150	"	300
5.	Gray sand shells, coal, slate and some lime,	20	"	320
6.	SS. dark-gray, micaceous,	15	"	335
7.	" gray, friable, some slate,	25	"	360
8.	" white, massive,	55	"	415
9.	" and dark slate,	20	"	435
10.	" white, massive,	75	"	510
11.	" and coal slate,	20	"	530
12.	" white, massive,	50	"	580
13.	Slate; fossils, lime,	30	"	610
14.	Silicious limestone, gray,	25	"	635
15.	Limestone, slaty,	15	"	650
16.	Red sandy slate, much lime,	20	"	670
17.	Siliceous limestone, white,	70	"	740
18.	" " , gray and red mixed,	20	"	760
19.	Slate, dark, sandy,	60	"	820
20.	SS. gray, micaceous, friable,	80	"	900
21.	" yellowish hard,	40	"	940
22.	" white, friable,	80	"	1020
23.	Slaty sandstone, dark-gray, micaceous,	40	"	1060
24.	Sandy slate,	70	"	1130
25.	Slate,	115	"	1245
26.	SS. yellowish, massive, lime,	45	"	1290
27.	Slate and shells	30	"	1320
28.	" sandy,	37	"	1357
29.	SS. gas sand, not through,	13	"	1370

Wilkin well No. 1.

1886.

Located at Murraysville and owned by the Philadelphia Natural Gas Co. of Pittsburgh. Record from specimens preserved in the company's office.

Spec. Nos.				
	Well mouth above ocean in feet			
	Conductor	15	to	15
1.	SS. gray and brownish, slaty structure,	9	"	24
2.	Slate, black, a little sand,	26	"	50
3.	SS. white, friable, massive,	70	"	120
4.	Black slate and shaly, micaceous sands,	144	"	264
5.	SS. dark, gray, friable,	20	"	284
6.	SS. and sandy shale,	28	"	312
7.	Slate, dark, shaly,	63	"	375
8.	SS. dark-gray, friable, micaceous,	42	"	417
9.	SS. white, massive,	62	"	479
10.	" white and black, slaty structure,	42	"	521
11.	Sandy shale, dark,	44	"	565
12.	Slate, gritty,	15	"	580
13.	Red slate, some lime,	42	"	622
14.	Limestone, black, slaty structure,	11	"	633
15.	SS. containing a great deal of lime,	144	"	777
16.	Slate, black,	13	"	790
17.	SS. gray, flaky, micaceous,	35	"	825
18.	Shale, slaty, black,	11	"	836
19.	SS. gray, flaky, micaceous,	199	"	1035
20.	Slate, gritty,	75	"	1110
21.	" " and micaceous,	115	"	1225
22.	" common,	35	"	1260
23.	SS. fine, massive,	32	"	1292
24.	Slate, common,	35	"	1327
25.	SS. containing considerable lime, (Gas sand,)	15	"	1342

These specimens were preserved and put in bottles by the drillers; each bottle being marked with number of feet it represented in the well. They evidently do not give a correct representation of the drillings. For instance No. 4 represents 144′ in the well where the strata are so changeable that one specimen gives a very poor idea of the whole. No. 15 is called Sandstone but it is silicious limestone. It represents 144′ in the well but must have been taken shortly after striking the so called sandstone, for we know that the lower part of this 144′ is a white sandstone without lime. The interval of 35′ feet between Nos. 23 and 25 is evidently too small; it is usually from 55′ to 75′. See Murray well No. 2 and Boulton & Doubleday No. 1. Spec. No. 25 contains considerable lime, much more than is to be found in this rock in any other locality where an opportunity has offered for testing it.

Boulton & Doubleday No. 1, On Lyons Run.

June 1883.

On the Joshua Cooper farm at Lyons Run, about 2 miles southwesterly from Murraysville and 300′ from Haymaker's Lyons Run well No. 1, the first well drilled there. Authority, Mr. Doubleday.

Well mouth above ocean, (barometer)				875
Conductor,	7	to	7	868
SS.	45	"	52	823
Coal,	1	"	53	822
Slate,	23	"	76	799
Coal,	1	"	77	798
Slate,	77	"	154	721
SS.	50	"	204	671
Slate,	45	"	249	626
Slate & shells,	40	"	289	586
SS.	80	"	369	506
Slate,	20	"	389	486
SS.	105	"	494	381
Slate,	5	"	499	376
Slate & shells,	16	"	515	360
Red rock,	20	"	535	340
Slate & shells, (cased at 550 ±,)	20	"	555	320
SS.	145	"	700	175
Slate,	15	"	715	160
SS.	77	"	792	83
Slate,	3	"	795	+ 80
SS.	80	"	875	00
Slate,	5	"	880	— 5
SS.	200	"	1080	—205
Slate,	115	"	1195	—320
SS. (salt water,)	30	"	1225	—350
Slate,	80	"	1305	—430
SS.—gas rock—not through,	7	"	1312	—437

A very strong gas well.

Hukill well No. 1.

Comp. Feb. 1884.

Owners, Carpenter Natural Gas Company.

Located on the Dick farm, Penn township, Westmoreland county.

Authority Mr. E. M. Hukill.

Well mouth above ocean, by levels taken from Stewarts Sta.				1109
Slate and sand,	445	to	445	=664
SS. (little salt water at 485′,)	40	"	485	624
" " " "	60	"	545	564
" " " "	180	"	725	384
" much " "	115	"	840	+269
" little " "	315	"	1155	— 46
" " " "	135	"	1290	—181
Slate,	3	"	1293	—184
SS.	97	"	1390	—281
Slate,	70	"	1460	—351
SS. (Salt water & gas,)	45	"	1505	—396
Slate & Shale,	59	"	1564	—455
SS. (gas came in 2′ from top) not through,	16	"	1580	—471

Cased with heavy 4¼ inch casing at about 1510.

Moderate flow of dry and almost odorless gas.

Hukill Well No. 3. McWilliams farm.

Completed Nov. 1884.

About 45 rods east of Dick farm well. Drilling and casing similar to Dick farm.

Elevation 1150′—Depth 1649′.

A very strong flow of gas.

Hukill well No. 2. Daum farm.

Completed Aug. 1884.

Depth 1690′. Lowest water at about 1200′.

Cased with heavy 4¼ inch casing at 1210′.

Hukill well.

1883.

Located on the Lentz farm, near Carpenter's Station, North Huntingdon township, Westmoreland county. Owners The Carpenter Natural Gas Company. Authority E. M. Hukill.

Well mouth above ocean in ft., (4′ below Carpenter's Station,)				= 850
Conductor,	10	to	10	840
SS.	40	"	50	800
Slate, black,	5	"	55	795
SS. white,	65	"	120	730
Slate, black,	10	"	130	720

Coal,		2	"	132	718
Fire clay,		65	"	197	653
Coal,		2	"	199	651
Fire clay,		9	"	208	642
SS. gray,		30	"	238	612
Slate,		5	"	243	607
SS. hard,	6	63	"	306	544
" soft,	44				
" hard,	13				
Slate,		15	"	321	529
SS.		5	"	326	524
Slate and shells,		45	"	371	479
Slate, black,		27	"	398	452
Coal,		7	"	405	445
Fire clay,		12	"	417	433
Shale and shells,		16	"	433	417
SS.		16	"	449	401
Slate, (cased 491',)		55	"	504	346
SS. white, (salt water,)	64	173	"	677	173
" " (little gas,)	62				
" " (salt water,)	10				
" " (very hard,)	37				
Slate,		15	"	692	158
SS. gray,	10	44	"	736	114
SS. white,	34				
Slate, black,		15	"	751	99
SS. (little salt water,)		12	"	763	87
Slate and shells,		35	"	798	+ 52
SS. gray, (quite a flow of gas,)	8	158	"	956	— 106
" white,	70				
" gray, (little salt water,)	20				
" white,	60				
Slate and shells,		12	"	968	— 118
SS. white,		70	"	1038	— 188
Slate,		3	"	1041	— 191
SS. white,		77	"	1118	— 268
Slate and shells,		138	"	1256	— 406
SS.		63	"	1319	— 469
Slate,		15	"	1334	— 484
SS. gray,		7	"	1341	— 491
Slate,		35	"	1376	— 526
SS.		5	"	1381	— 531
Slate,		4	"	1385	— 535
SS.		5	"	1390	— 540
Slate,		3	"	1393	— 543
SS. (salt water,)		47	"	1440	— 590
Slate,		36	"	1476	— 626
Slate and sand,		30	"	1506	— 656
SS. (soda water on top) not through,		35	"	1541	— 691

Carpenter Natural Gas Co. No. 1.

On Thos. Martin farm, in the valley of Pine Run, Washington township, Westmorland Co. Authority—drillers record.

Well mouth above ocean in feet, (barometer,)				1010
Conductor,	16	to	16	994
Slate,	54	"	70	940
SS.	30	"	100	910
Slate and sand,	90	"	190	820
Coal and slate,	10	"	200	810
SS. white,	15	"	215	795
Coal,	5	"	220	790
Limestone,	8	"	228	782
Bastard oil rock,	10	"	238	772
Slate,	22	"	260	750
Mountain sand,	100	"	360	650
Slate,	40	"	400	610
SS. black,	15	"	415	595
" white,	40	"	455	555
" " shelly,	30	"	485	525
?	40	"	525	485
Salt-water shell,	5	"	530	480
SS. white,	50	"	580	430
? (Cased at 628,)	48	"	628	382
Slate,	47	"	675	335
SS. black,	30	"	705	305
SS. white, (some gas at 860,)	155	"	860	+150
SS.	240	"	1100	— 90
Slate and sand shells,	335	"	1435	—425
Stray sand,	20	"	1455	—445
Slate,	20	"	1475	—465
SS.	30	"	1505	—495
Loose sand and shale,	95	"	1600	—590
Clover seed sand,	10	"	1610	—600
SS. blue, hard fine,	10	"	1620	—610
Slate,	10	"	1630	—620
SS. pebbly, (strong gas) not through,	8	"	1638	—628

Parnassus well.

Summer 1883.

On Pucketta Creek, Geo. Thompson farm, Burrell township, Westmoreland County, about 5 miles from Allegheny river.

Salt water and no gas of importance.

Beaver Valley well.

Oct. 1878.

On Beaver run in Washington township, Westmoreland

County, 2½ miles due east of North Washington and about 9 miles northeast of Murrysville.

Record kept. by J. A. Mehaffey one of the owners.

Freeport Coal 3½′ thick out crops 4′ above well mouth.

Well mouth above ocean in feet, (barometer,)				1005
Conductor,	12	to	12	993
Black slate,	20	"	32	973
Limestone,	8	"	40	965
Coal,	6	"	46	959
Fireclay,	11	"	57	948
Hard shell,	1	"	58	947
Soapstone,	5	"	63	942
Black slate,	50	"	113	892
Soapstone,	5	"	118	887
Black slate,	5	"	123	882
Coal slate,	6	"	129	876
Mountain sand,	30	"	159	846
Black slate,	8	"	167	838
SS. gray,	11	"	178	827
Black slate,	31	"	209	796
SS.	5	"	214	791
Coal,	4	"	218	787
Fire clay,	25	"	243	762
Iron ore,	6	"	249	756
Soapstone,	2	"	251	754
Fire clay,	18	"	269	736
Pebble sandstone,	3	"	272	733
White clay,	12	"	284	721
SS. gray,	30	"	314	691
Pebble sandstone, (some oil, like Greensburg oil,)	2	"	316	689
Fire clay,	5	"	321	684
Hard shell,	5	"	326	679
" " salt water,	10	"	336	669
Black slate,	70	"	406	599
Sand shells,	4	"	410	595
SS. gray,	26	"	436	569
White mud,	15	"	451	554
Black slate,	10	"	461	544
Shells—salt water,	3	"	464	541
White mud,	5	"	469	536
Red rock,	4	"	473	532
Black slate,	14	"	487	518
Shells-salt water,	4	"	491	514
SS. white,	18	"	509	496
Gray shells,	2	"	511	494
SS. white—"1st Sand,"	91	"	602	403
Shells—salt water,	5	"	607	398
SS. white,	20	"	627	378
SS. white, with a crevice, (cased at 646′,)	20	"	647	358

Black and white slate,	15	"	662	343
SS. gray, crevices in center,	20	"	682	323
Hard gray shells,	6	"	688	317
Gray slate,	36	"	724	281
SS. gray, hard,	140	"	864	141
Black slate,	5	"	869	136
" " hard, (salt water at 907',)	40	"	909	96
Black rock,	5	"	914	91
SS. gray,	35	"	949	56
Black shells,	5	"	954	51
White " (Omitted in record,)	(?)50	"	1004	+ 1
SS. gray hard,	2	"	1006	— 1
" white,	10	"	1016	— 11
White mud,	8	"	1024	— 19
SS. white,	5	"	1029	— 24
" black,	2	"	1031	— 26
" gray,	6	"	1037	— 32
" " shells,	3	"	1040	— 35
Gray mud,	6	"	1046	— 41
SS. white,	10	"	1056	— 51
Black slate,	8	"	1064	— 59
White mud,	6	"	1070	— 65
Hard shells,	5	"	1075	— 70
Gray "	2	"	1077	— 72
White "	12	"	1089	— 84
Black "	2	"	1091	— 86
SS. gray,	3	"	1094	— 89
Slate, black,	12	"	1106	—101
Gray shells,	8	"	1114	—109
Black "	5	"	1119	—114
(Omitted in the record), (?)	58	"	1177	—172
White mud,	10	"	1187	—182
SS. black,	10	"	1197	—192
SS. showing scum of oil,	35	"	1232	—227
Mud & shells,	8	"	1240	—235
Shells—salt water,	8	"	1248	—243
" white,	6	"	1254	—249
" gray, hard,	5	"	1259	—254
" blue, hard (36 hours drilling 10'),	10	"	1269	—264
Pebble sand and gas at 1271',	4	"	1273	—268
Blue & Soft,	20	"	1293	—288
SS. gray coarse, hard, to bottom,	8	"	1301	—296

This well was completed a short time before the old Haymaker well at Murrysville and Mr. Mehaffey's opinion is that it was nearly as large a gasser.

The record was very minutely kept, but in copying it I discovered two places where the footings of the several divisions would not agree with the depths given in the well. Probably something had been omitted. These omissions make this record of *uncertain value* for we cannot tell just where the missing links should be supplied, If drillers would adopt our method of keeping records, such errors could not occur.

The gas from this well was never utilized in any way.

Well Records in Allegheny county.

Jones & Laughlins' well No. 1.

Commenced July 10 1884. Completed April 10 1885.

Located on the east side of 26th St. near the river; 25th Ward, Pittsburgh, South side, at Messrs. Jones & Laughlin's American Iron & Steel works. Compiled from specimens presented by Mr. F. T. Gretton, Chemist in charge at steel works.

Specimen Nos.				
	Well mouth above ocean in feet,			785
1 & 2.	Surface gravels—Drive pipe,	80 to	80	655
3.	Sandy slate and sand shells,	15 "	95	640
4.	Slate, lead color,	15 "	110	625
5—10.	SS. white. medium grain, friable, mica,	60 "	170	565
11.	Shaly sandstone. fine, gray-black, mica,	15 "	185	550
12—15.	SS. gray, fine, a little slate near center,	33 "	218	517
16.	Slate,	12 "	230	505
17—21.	Sandy slate & shale, very fine, mica, some gray limestone and coal slate near top, trace of lime all through	58 "	288	447
22—23.	Sandy slate & shells, dark,	27 "	315	420
24.	Slate, black, and trace of coal,	20 "	335	400
25—27.	Sandy slate & shells, faint trace of lime,	35 "	370	365
28—32.	SS. white, fine, mica; grayish at top & bottom,	70 "	440	295
33—34.	Slate, black, coal, (Drillers say 3′ of coal),	10 "	450	285
35—37.	Sandy slate, dark, granulating like sand,	55 "	505	230
38.	" " and brown and white shells, trace coal,	15 "	520	215
39.	Sandy slate, gray, fine, mica, large percentage of lime,	20 "	540	195
40—41.	Slate, black,	45 "	585	150
42.	Sandy slate & sandstone, fine, dark brownish-gray,	10 "	595	140
43—47.	SS. white, medium, compact, white specks,	50 "	645	90
48.	Slate, black, trace of coal,	10 "	655	80
49—50.	SS. dark ash-gray, fine, friable,	25 "	680	55
51—53.	Sandy slate, chocolate-brown, fine, mica,	30 "	710	25
54—55.	Slate, dark, with gray shells,	20 "	730	+ 5

56—58.	SS. white, medium, compact, ...	40	"	770	— 35
59—60.	Slate, black, with some coal, ...	20	"	790	— 55
	? specimens omitted, ...	35	"	825	— 90
61—62.	Siliceous limestone, (white sand and buff limestone), ...	20	to	845	— 110
63.	Siliceous limestone, like bluish sandy shale, ...	8	"	853	— 118
64—65.	Siliceous limestone, like light gray sand, ...	27	"	880	— 145
66—67.	Slate & gray sand shells, ...	30	"	910	— 175
68—69.	Sandy slate, dark gray, fine, mica, . .	35	"	945	— 210
70—82.	SS. white, medium, compact, some dark slate at 1045′ and 1080′	160	"	1105	— 370
83—84.	Slate, dark, pure, ...	60	"	1165	— 430
85—87.	White sand, and dark sandy slate, "salt and pepper rock,"	35	"	1200	— 465
88.	Sandy slate & slate, bluish, ...	20	"	1220	— 485
89—92.	SS. grayish, fine, flaky, mica, (white in center), ...	55	"	1275	— 540
93—94.	SS. grayish, fine, flaky, mica, with layers of dark slate, ...	20	"	1295	— 560
95.	Slate, a little sandy, ... 20	130	"	1425	— 690
96—98.	" common, ... 45				
99—103.	" a little sandy, ... 65				
104—106.	SS. gray, fine, some lime,—"Gas sand,"	25	"	1450	— 715
107—112.	Slate, common, little sandy top & bottom, ...	75	"	1525	— 790
113—122.	SS. white, top fine, center & bottom quite coarse, ...	93	"	1618	— 883
123.	Slate, black, granulating like sand, . . .	7	"	1625	— 890
124.	SS. fine, white & brown mixed, ...	10	"	1635	— 900
125—127.	Slate & shells, dark, ...	8	"	1643	— 908
128—131.	SS. white, top grayish and mixed with sandy slate, bottom white, little slate; Pebble shell at 1650, ...	25	"	1668	— 933
132.	Slate & sandy shells, ...	7	"	1675	— 940
133—138.	SS. white, medium, (Pebble shell at 1705′), ...	45	"	1720	— 985
139.	Sandy shale—red and green, ...	20	"	1740	—1005
140.	Slate & shells, ...	15	"	1755	—1020
141.	" common, ...	43	"	1798	—1063
142—147.	SS. pebbly, (Say 2′ pebbles and 5 grayish sand, fine), good flow of gas, . .	7	"	1805	—1070
148.	Slate, black, iron pyrites, (probably some shells at top), ...	15	"	1820	—1085
149—150.	Slate, dark, with greenish-gray shells & streaks of red, ...	13	"	1833	—1098
151—152.	Slate, blue black, ...	27	"	1860	—1125
153—154.	SS. yellowish-gray, fine, very hard, . .	8	"	1868	—1133
155.	Slate & shells, ...	12	"	1880	—1145

156.	Sandy slate, red and green, soft, with very red clay,	10	"	1890	—1155
157—160.	SS. yellowish-gray, fine hard,	10	"	1900	—1165
161.	Slate & shells, bluish-gray,	3	"	1903	—1168
162—164.	" " greenish-gray, and red,	12	"	1915	—1180
165—169.	SS. yellowish-gray, medium,	7	"	1922	—1187
170—174.	Slate, common,	24	"	1946	—1211
175—176.	" & shells,	8	"	1954	—1219
177—179.	SS. yellowish-gray, medium, very hard,	2	"	1956	—1221
180.	Slate & sand, greenish-gray & red, lime,	3	"	1959	—1224
181—182.	SS. greenish-gray, with reddish slate,	3	"	1962	—1227
183.	Slate & shells,	6	"	1968	—1233
184—185.	Slate, sandy,	11	"	1979	—1244
186—187.	SS. white, fine, mica, flaky, hard,	7	"	1986	—1251
188—191.	Slate, common,	22	"	2008	—1273
192—195.	" with sand shells,	17	"	2025	—1290
196—201.	SS. white, very fine & hard,	9	"	2034	—1299
202—224.	Slate, common,	132	"	2166	—1431
225—239.	" sandy, with some reddish layers,	77	"	2243	—1508
240—264.	" a portion of it shelly,	148	"	2391	—1656
265—279.	" sandy, much mica, bailings sometimes dark red,	90	"	2481	—1746
280—301.	Slate common, fossils at 2485′	136	"	2617	—1882
302—303.	SS. & slate, brownish-gray, micaceous,	4	"	2621	—1886
304—310.	Slate, with 2′ fossil band at 2660′,	44	"	2665	—1930
311—351.	Slate, with pyrites & some fossils,	246	"	2911	—2176
352—362.	" some fossil bands.	89	"	3000	—2265

Mr. Gretton's notes.—Cased with 5⅝ inch casing at 433′, 656′, 775′ and finally at 1720′. From 1720′ to the bottom of the well, (3000′) the drill hole is 5½ inches in diameter.

Salt-water and a little gas at 360′. Salt-water at 480′. Salt-water and gas at 510′. Large flow of salt-water and foul gas from 1525′ to 1618′. Good flow of gas at 1798′, and still better at 1804′. Little salt water at about 2400.′ At 2625′ ten bailers of salt water accumulated in the hole while work was stopped over Sunday. No increase of water was noticed below this.

Sept. 5th, 7 o'clock, A. M.—Salt-water sand struck at 1525.′ Water immediately made its appearance, and at 9 P. M., when about 10′ in the sand the hole had filled up 400 feet.

Sept. 6th., 7.30 A. M.—Well flowing about five gallons of salt water per minute over the casing head. Foul gas accompanies it.

Sept. 8th, 8 A. M.—Salt-water increased; gas as before.

Temperature of water in the well, five feet below top of casing, 66.2° F. Specific gravity at 59° F.=1.075. Assuming all solids present in the water to be sodium chloride, or common salt, the percentage of the same, estimated by gravity is about 10 per cent.

Nov. 18.—Gas struck at 1798′ but it shows signs of diminishing.

Dec. 12.—Large flow of gas at 1804,′ in a good pebble sand which the drillers think is not over two feet thick, that is the pebbly portion of it.

[This well was drilled 3000 feet deep as an experiment, but without any perceptible increase of gas. After passing through the 9 foot sand at 2034′, the drill pierced 966 of slaty shales without encountering any more sand. The sand-pump brought up nothing but the characteristic typical Chemung slates and shales which are found universally beneath the Venango Oil group in all the deep wells drilled along its axis.

The hole was afterwards filled up to about 1870 feet. Tubing was then inserted, so that the salt water could be pumped out whenever it accumulated, and the gas thus constantly protected from its most dangerous foe is still flowing, (January 1, 1887) with as much vigor, apparently, as when it was first utilized in lighting the Iron Works nearly two years ago.]

Jones and Laughlins' well No. 2.

Commenced Jan. 7. Finished May 27, 1885.

Located at the American Iron and Steel Works at the foot of 30th St., 24th Ward, Pittsburgh, and about 600 yds east of No. 1.

Spec. Nos.					
	Well mouth above ocean in feet, about				730
1— 6.	Gravel and clay, (drive pipe,)	70	to	70	660
7— 8.	SS. dark gray, some lime,	10	"	80	650
9— 10.	Slate, lead color,	35	"	115	615
11— 13.	SS. white, friable, soft,	55	"	170	560
14— 15.	Slate, black, and slaty limestone,	30	"	200	530
16.	Sandy shale, blue-gray,	5	"	205	525
17.	Slate, lead color and red,	15	"	220	510

18.	" " " no red, sandy, . . .	35	"	255		475
——	" " " and red, ...	5	"	260		470
19— 21.	" " " little red, ...	60	"	320		410
22— 23.	" , black, pyrites, trace coal, . .	25	"	345		385
24.	" sandy and shaly, gray, . . .	15	"	360		370
25— 26.	SS. white and black slate; "pepper and salt rock,"	20	"	380		350
27.	Slate, black, trace coal, pyrites, . .	5	"	385		345
——	SS. white, like No. 26 (no spec.) . . .	8	"	393		337
28.	Sandy shale (no salt water, no gas to this point,)	7	"	400		330
29— 33.	SS. grayish-white, friable, micaceous,	54	"	454		276
34.	Slate, black, trace coal, pyrites, . .	6	"	460		270
35.	Coal slate and coal, (6" coal at 463') .	5	"	465		265
36.	Slate, black, and fire clay, ...	5	"	470		260
37.	Slate and sandy shale, dark, ...	25	"	495		235
38.	Coal (3' 6") Coal slate and fossils, (pocket of gas at 495',)	5	"	500		230
39— 43.	Slate, black, fire clay at top, ...	28	"	528		202
44— 45.	SS. white, fine, ...	7	"	535		195
46.	Slaty shale and fine sand, ...	5	"	540		190
47.	Sandy calcareous shale—Ferriferous limestone?	10	"	550		180
48— 50.	Slate, dark, ...	35	"	585		145
51— 52.	" with sand shells, ...	20	"	605		125
53— 61.	SS. white, massive, some salt water, .	45	"	650		80
62— 63.	Slate, black, trace coal, (pocket of gas at 650')	15	"	665		65
64— 66.	Slate dark, with sand shells, ...	20	"	685		45
67.	Coal and coal slate and white SS. . . .	5	"	690		40
68.	SS. grayish-white, fine, ...	5	"	695		35
69.	Coal, coal slate and white SS.	10	"	705		25
70— 72.	Sandy slate, or SS. and black slate, (pocket of gas,)	18	"	723	+	7
73— 78.	SS. gray-white, slaty in center, compact top and bottom, ...	42	"	765	—	35
79— 82.	Sandy shale, dark: trace coal at 775', (gas pocket.) 1' coal at 795', ...	33	"	798	—	68
83— 84.	SS. and black slate—"salt and pepper,"	7	"	805	—	75
85.	Slate, black, sandy, trace coal, ...	7	"	812	—	82
86— 87.	Shaly limestone, trace coal, fire clay, .	8	"	820	—	90
88— 90.	Slaty limestone, granulating like sand,	15	"	835	—	105
91.	Silicious limestone, white sand and trace of coal, ...	5	"	840	—	110
92— 97.	Silicious limestone, (870' to 880' very hard,)	51	"	891	—	161
98— 99.	Slate dark, some fine sand, ...	9	"	900	—	170
100.	Slate and shells, lead color, ...	5	"	905	—	175
101—104.	Sandy slate, ...	30	"	935	—	205
105—119.	SS. white, friable, flaky: trace coal at top, ...	140	"	1075	—	345
120—121.	SS. white, with black slate, ...	10	"	1085	—	355

122—124.	" " flaky, not solid, (Well dry here; no gas,)	20	" 1105 —	375
125—127.	Slate, dark,	35	" 1140 —	410
128—131.	Sand and shells, lead color,	80	" 1220 —	490
132—138.	SS. light-gray, fine (some slate streaks near center,)	70	" 1290 —	560
139—140.	Slate, black, gritty,	10	" 1300 —	570
141—151.	" gray, gritty, micaceous,	110	" 1410 —	680
152.	" sandy fossil bands, lime,	5	" 1415 —	685
153.	SS. and sandy shale, fine,	20	" 1435 —	705
154—161.	Slate, common,	76	" 1511 —	781
162—173.	SS. grayish-white, medium grain, (salt water,)	95	" 1606 —	876
174—178.	Slate, sandy, black, (cased at 1610′) .	25	" 1631 —	901
179.	SS. white,	4	" 1635 —	905
180—181.	Slate and shells,	10	" 1645 —	915
182.	SS. white, hard,	5	" 1650 —	920
183—184.	Slate and shells,	10	" 1660 —	930
185—197.	SS. white, pebbly in streaks, hard, (gas and salt water.)	45	" 1705 —	975
198—199.	Slate and sandy shale,	12	" 1717 —	987
200—201.	SS. with greenish and red slate,	7	" 1724 —	994
202—211.	Slate and shells,	56	" 1780 —	1050
212.	SS. hard shell,	3	" 1783 —	1053
213—215.	" pebbly (Gas at 1792′)	9	" 1792 —	1062
216—219.	" white,	5	" 1797 —	1067
220—223.	State,	21	" 1818 —	1088
224.	Red rock and slate to bottom,	8	" 1826 —	1096

Mr. Gretton's notes.—The coal at 495′ is about 3′, 6″ thick; a pure cannel, merging into a glossy coal. A large flow of gas came from the coal seam, nearly strong enough to throw 480′ of water out of the hole. When lit the flame extended ten feet above the derrick floor. It exhausted, however, after five hours, and then could only be ignited when the water in the well was agitated.

At 710′ struck a large pocket of gas which caused the water to flow out over the derrick floor. Drilling suspended and fires put out, but in about two hours and a half the gas exhausted. It had an oily smell.

The coal in the Siliceous limestone at 840′, is the brightest and best seen in the well. As the 8 inch casing is not yet in, there is some doubt about its exact location. The drillers did not notice it in drilling, and therefore, if it came from this bit, its thickness cannot be very great.

Salt water sand struck at 1511′, and well dry. At 1517′ about 400′ of water in the hole. At 1535′ the muddy, foaming water begins to flow over the casing head, although there is hardly sufficient gas to ignite. At 1551′ the water inceased, then flowed intermittently, sometimes resting several hours and settling 50′ or more below the casing head. But at 1585′ it gained new strength and then increased with every screw down to the bottom of the sand at 1606′. Temperature of water 68° F. Specific gravity at 59° F. = 1.0725. Water very clear. One pint of water, (U. S. Standard) at 59° F. (15° C.) weighs 1 lb. 1 oz. 13 drachms. One pint of water, (U. S. Standard) yields on evaporation to *perfect* dryness, 1 oz. 13 drachms of salty residue.

At 1690′, dry hole and no gas, the salt water having been completely cased off at 1610′. At 1698′ small flow of gas, petroleum odor; flame from a 2 inch pipe rises 5 feet high. At 1705′ a little salt water, no increase of gas.

May 15, 1885.—Large flow of gas at 1792′. As soon as top shell was pierced the gas cleaned the hole of water and drillings. While drilling was suspended to make gas connections, the hole filled up about 600′ with water. The tools were run down and upon withdrawing them the gas blew the water out of the hole, making a fountain higher than the derrick.

In consequence of the salt water in this well, it does not produce as much gas as well No. 1.

Morehead & Co. well.

Nov. 5, 1884.

Located on property of Morehead & Co., at Soho station, 2d Avenue, east of Brady St., 14th Ward, Pittsburgh. From Co.'s record book.

Well mouth above ocean in feet, about				730
Conductor,	40	to	40	690
SS. blue,	11	"	51	679
SS. reddish, (water,)	5	"	56	674
Soapstone,	5	"	61	669
SS. blue,	41	"	102	628
Slate, black,	14	"	116	614
SS. white, (salt water at 200′,)	84	"	200	580
Sandy slate, black, (1′ coal and gas 260′,)	80	"	280	450

SS. gray,	12	"	292	438
" white, (salt water at 325',)	33	"	325	405
Sandy slate,	30	"	355	375
" " and shells, (salt water at 380',)	45	"	400	330
SS. blue, close,	28	"	428	302
Slate, black,	47	"	475	255
SS. blue, (salt water at 480',)	35	"	510	220
" white close, (salt water at 550',)	40	"	550	180
Sandy slate, (gas at 595',)	45	"	595	135
SS. white, coarse, (gas at 618',	59	"	654	76
Slate, black,	68	"	722	+ 8
SS. white,	20	"	742	— 12
Slate, black,	98	"	840	— 110
SS. gray with limestone,	10	"	850	— 120
" white, with pebbles,	10	"	860	— 130
" white, close, (little gas at 940',)	80	"	940	— 210
Slate, black,	5	"	945	— 215
SS. grayish, shelly, (gas at 950',)	5	"	950	— 220
" white, coarse, (cased 5⅝ casing at 1030',)	97	"	1047	— 317
" blue, close,	8	"	1055	— 325
Slate,	2	"	1057	— 327
SS. gray,	55	"	1112	— 382
" white,	11	"	1123	— 393
Slate black,	87	"	1210	— 480
SS. blue, very hard,	80	"	1290	— 560
Slate, black,	20	"	1310	— 580
SS. black (!)	120	"	1430	— 700
" white,	20	"	1450	— 720
Sandy slate, black, (much salt water at 1530',)	80	"	1530	— 800
SS. gray,	30	"	1560	— 830
" white, pebbly,	20	"	1580	— 850
" black, (cased with 4¼ casing at 1625',)	60	"	1640	— 910
" gray, fine, hard,	25	"	1665	— 935
" shells and some red,	210	"	1875	—1145
" white, fine, (oil show,)	25	"	1900	—1170
Slate and shells, (12' red at 1950',)	100	"	2000	—1270
Slate,	7	"	2007	—1277

The 5⅝ inch casing was first inserted at 331', but had to be drawn and put deeper as the water veins were struck, until it finally extended down to 1030'. The gas coming up with the salt water outside of the 4¼ casing is still (Jan. 1, 1885) of ample volume to heat and light the Co.'s office. The principal part of this is supposed to come from 618'. The gas struck at 950' was very promising at first, flowing freely and having a pressure of 65 lbs. to the inch, but after about 12 hours exhausted. A scum of oil was noticed at 1530', and from 1875 to 1900 a bucket full was secured. This was dark colored and of heavy gravity. As the well stands it is practically a dry hole below the casing. No water, no oil, no gas.

Graff, Bennett & Co. Well.

Located at their Iron works on Carson Street, in 33d Ward of City of Pittsburgh, South Side, about midway between Sheffield St. bridge and Point bridge.

Copied from specimens preserved in Co.'s office.

Nos.			
	Well mouth above ocean in feet, about,		745
1.	SS. dark,	at 600′	145
2.	" gray,	" 630	115
3.	Sandy shale, very dark,	" 642	103
4.	" " gray,	" 675	70
5.	SS. white, medium grain,	" 685	60
6.	Slate, dark,	" 698	47
7.	SS. white, fine, close,	" 700	45
8.	" " " "	" 710	35
9.	" " coarser,	" 740	+ 5
10.	Slate, sandy,	" 760	— 15
11.	SS. white, medium, some lime,	" 840	— 95
12.	" " " some lime,	" 855	—110
13.	" gray, quite coarse,	" 930	—185
14.	Slate and shells,	" 970	—225
15.	Sandy shale, dark,	" 1008	—263
16.	SS. white,	" 1040	—295
17.	" grayish,	" 1075	—330
18.	" " friable,	" 1100	—355
19.	" " "	" 1165	—420
20.	" " hard "50 ft.,"	" 1200	—455
21.	" " coarser,	" 1250	—505
22.	" " "10 ft.,"	" 1265	—520
23.	" "	" 1420	—675
24.	" white very fine, Salt water,	" 1500	—755
25.	" grayish " " "	" 1510	—765
26.	Slate, common, to bottom, say 27′,	to 1577	—832

Well flooded with salt water and abandoned.

No written record was kept and the specimens preserved are only marked to show the depth at which they were taken. A detailed section, therefore, cannot be made with accuracy, for there is no way of ascertaining the thickness of the several strata. The samples lose much of their value, also, from the fact of having been put into bottles while wet. Many of them are already so disguised by the oxydation of fine particles of steel worn from the drill that their normal color can hardly be ascertained.

A large flow of salt water was found in the last sandrock, and after the drill had pierced about 25′ in the slates below it, work was suspended.

A copious stream of salt and tepid water is now flowing from the well mouth, and it is accompanied by some fetid gas, the same as in Painter, Boyd Hill, and other wells which have pierced this great salt water horizon.

Painter Well.

Completed Nov. 27, 1884.

Located at the Iron works of J. Painter & Sons on W. Carson St. 34th Ward, Pittburgh; being under the cliffs on the S. bank of the Ohio river, about midway between the Point bridge and Temperanceville. Compiled from a set of 94 sand pumpings, preserved by Mr. Harper, Supt. of Iron works.

Specimen. Nos.					
	Well mouth above ocean in feet, (barometer, ...				730
	? no specimen, ...	40	"	40	690
1.	Sandy shale and clay, light gray, . .	30	"	70	660
2.	Slate. gray, ...	40	"	100	630
3.	Shale, dark, fossils, ...	5	"	105	625
4.	Slaty sandstone, thin layers, micaceous.	15	"	120	610
5— 6.	SS. ash-gray, friable, medium grain, mica, ...	25	"	145	585
7.	Slate, dark, gritty, micaceous, ...	15	"	160	570
8.	Shales. reddish and greenish, .	30	"	190	540
9.	Shale, sandy, trace of red and limestone, ...	23½	"	213½	516½
10.	Coal slate with little coal, ...	4½	"	218	512
11.	SS. gray, with equal portion of dark slate, ...	8	"	226	504
12—13.	Slate, dark, ...	34	"	260	470
14.	Dark shales and gray sand shells, .	40	"	300	430
15.	Slaty shale, dark, clayey, . . .	50	"	350	380
16.	SS. gray, and black sandy slate, fine, hard, .	20	"	370	360
17.	Sandy slate and shale, gray, micaceous,	15	"	385	345
18.	Slate, common, ...	38½	"	423½	306½
19.	Coal, bright and good, ...	4½	"	428	302
20—22.	SS. friable, dark-gray, fine, (salt water,)	52	"	480	250
23—25.	Slate, ...	95	"	575	155
26—30.	SS. white friable, (salt water,) . . .	57	"	632	98

31.	Slate, common, (salt water,)	28	"	655	75
32—33.	SS. white, friable, little gas, ...	25	to	680	56
34.	Gray sand shells and slate, ...	15	"	695	+ 35
35.	Slate, dark, ...	50	"	745	— 15
36.	Slaty shales, sandy, micaceous, . . .	15	"	760	— 30
37.	Slate, common, . . .	25	"	785	— 55
38.	SS. gray, with black sandy slate and limestone, ...	10	"	795	— 65
39.	Sand shells, gray, and limestone, . .	10	"	805	— 75
40—42.	SS. light gray limestone, (?)	55	"	860	— 130
43.	Shaly slate, dark, gritty, . .	15	"	875	— 145
44—45.	SS. white, with black, slaty. shale .	20	"	895	— 165
46—53.	SS. white and grayish, friable, massive, ...	175	"	1070	— 340
54.	Slate, common, ...	35	"	1105	— 375
55.	SS. brownish-gray, very fine, tough,	30	"	1135	— 405
56—57.	Slate, common, ...	30	"	1165	— 435
58—59.	SS. greenish-gray, fine, flaky, mica,.	35	"	1200	— 470
60.	Slate, common, ...	60	"	1260	— 530
61.	SS. greenish-gray, fine, flaky, mica,	10	"	1270	— 540
62.	Slate, common, ...	100	"	1370	— 640
63—64.	Slate and shells, hard, ...	10	"	1380	— 650
65.	Slate, micaceous, .	45	"	1425	— 695
66—67.	SS. gray, fine, (much salt water,) .	45	"	1470	— 740
68—69.	Slate, dark, gritty, tough, . .	70	"	1540	— 810
70—76.	SS. gray top and bottom, white in center, (salt water,)	120	"	1660	— 930
77.	Slate, common, ...	5	"	1665	— 935
78.	" with red shales, ...	5	"	1670	— 940
79—81.	SS. white, fine, ...	25	"	1695	— 965
82.	Slate, common, ...	45	"	1740	—1010
83.	" , and shells, ...	40	"	1780	—1050
84.	" , common, ...	35	"	1815	—1085
85—86.	SS. dark-gray, fine, tough, ...	15	"	1830	—1100
87.	Slaty shale, red, with greenish gray shells, ...	8	"	1838	—1108
88.	SS. grayish, fine, hard, ...	17	"	1855	—1125
89.	Slate, common, ...	45	"	1900	—1170
90—91.	SS. white, flaky, ...	20	"	1920	—1190
	" and shells—no specimen, ...	52	"	1972	—1242
92.	" gray, medium, some small pebbles, (gas), ...	8	"	1980	—1250
93—94.	Slate, common, to bottom, ...	34	"	2014	—1284

Fresh water at 250′—cased here with 5⅝ casing. Salt water at 435′, 635′, and 705′. Casing (5⅝) drawn several times and finally carried down to 705.′ From this point down to 1430 the hole was perfectly dry. Here salt water of 10° strength came in and flowed over the casing head at the rate of 1500 bbls. per day as calculated from actual measurement of one hour's flow.

To shut out this salt water 1679 feet of 4¼ inch casing was inserted and thence to the bottom, the hole is only 4⅛ inches in diameter.

Gas was noticed at 665′, 995′, and in the last sand, but the quantity was insufficient to be of any practical value.

The well was commenced about the 20th of July, 1884, and completed on the 27th of November. On the 29th of Nov. an 18 qt. (60 lb.) shot of nitro-glycerine was exploded in the last sand, (1972 to 1980) and after standing an hour the gauge on the closed casing head showed a pressure of only 22½ lbs.

J. Painter & Sons are using gas in a portion of their iron works, (Jan. 1, 1885,) from the main leading from the McGuigan well, in Washington county. To regulate the pressure an escape pipe was carried up above the top of the derrick at their well, this being the most convenient and safest place to dispose of the waste when they have a surplus. This light burning at the top of the derrick has given rise to the report that the Painter well is a gas producer. As a gas well it is practically of no value whatever, and only affords another proof of the watered condition of the gas rock under Pittsburgh.

Parke Bro. & Co.'s well.

Oct., 1884.

In 15th Ward, Pittsburgh, on east side of 31st Street, between Penn Ave. and Smallman St. Authority, Mr. Parke.

Well mouth about 15′ below R. R., say				**780**
Gravel, sandstone and shale,	**100**	**to**	**100**	**680**
Coal,	**18**	**"**	**118**	**612**
Shale and sandstone (Cased at 600,)	**482**	**"**	**600**	**+ 130**
SS. and shale (dry to 1570,)	**970**	**"**	**1570**	**— 840**
SS. (much salt water,) drilled in SS.	**6**	**"**	**1576**	**— 846**

A little gas with the salt water, but not enough to be of any value. Well abandoned and dismantled.

Graff, Bennett & Co. well No 1.

March, 1883.

On their Furnace property at Millvale, Shaler township, Allegheny county, opposite 43rd Street, Pittsburgh.

Authority, the owners' record.

Well mouth above ocean in feet			
SS. gray,	260	to	260
Coal,	1	"	261
Slate, white,	6	"	267
Limestone,	12	"	279
Slate, white,	60	"	339
Coal,	2	"	341
SS. white,	65	"	406
Slate, black,	75	"	481
SS. white,	30	"	511
Slate, black,	92	"	603
SS. blue, hard,	5	"	608
SS. brown,	100	"	708
SS. and shells,	42	"	750
SS. white, hard,	66	"	816
Slate, black,	20	"	836
SS. gray,	214	"	1050
Slate and shells,	28	"	1078
SS. white, hard,	142	"	1220
Slate and shells,	136	"	1356
SS. hard, pale red,	4	"	1360
" white,	8	"	1368
Slate and shells,	203	"	1571
SS. red,	8	"	1579
Slate, white,	44	"	1623
SS. white, (salt water,)	28	"	1651
Slate, stopped drilling—about	4	"	1655

The well being a failure was abandoned and dismantled.

Graff, Bennett & Co. well No. 2.

Summer 1883.

On the old Sample farm, Gerties Run, Shaler township, Allegheny county, about a mile above well No. 1.

The drillers on this well were required to save specimens of the sand-pumpings at intervals of five feet all the way down. These specimens were put in large bottles and sent to Company's office. To make them more interesting, a long, narrow case with glass front was made and so graduated that every inch in length might represent a certain number of feet in the well. Glass partitions were then inserted wherever a change of materials occurred, and the bottles were emptied into these little bins. This makes as good an exhibit of the structure as the old method of putting the drillings by scale into a glass tube and is a preferable plan, for the top of the case can be opened at pleasure and the material in any one of the divisions examined without interfering in the least with the others.

But to make a case of this kind valuable, the specimens must be carefully taken and the measurements accurately made—two considerations which seem to have been overlooked in the G., B. & Co. well. Supposing that each bottle represented 5′ of drilling, the specimen case was made accordingly, but when the bottles were all emptied, it was discovered that they covered a depth of only 1205 feet while the well, at that time was known to be more than 100 feet deeper. How the discrepancy occured no one can tell, but it is proof positive that the specimens were very carelessly preserved, and, therefore, but little value can be put upon the following record copied from the aforesaid show case:

Surface clay,	10	to	10
SS. gray,	5	"	15
" " some slate,	30	"	45
" " alternating with slate,	40	"	85
Slate, sandy,	30	"	115
SS. dark-gray, micaceous,	45	"	160
Coal, bright and good,	5	"	165
Limestone, buff color,	10	"	175
Slate and sandy shale, dark,	70	"	245
SS. white,	35	"	280
Slate, sandy,	20	"	300
SS. white,	5	"	305
Slate, common,	80	"	385
SS. grayish, with white specks,	80	"	465
Slate,	60	"	525
" dark and fine sand shells,	35	"	560
Slate,	5	"	565
SS. gray,	5	"	570
Slate,	105	"	675
SS. brownish,	10	"	685
Slate,	5	"	690
SS. of several shades, some slate and probably some limestone,	155	"	845
SS. white, medium grain at top, finer and harder at bottom,	115	"	960
Slate, common,	55	"	1015
SS. dark-gray, with sandy slate in layers, fine grained,	105	"	1120
Slate, common,	85	"	1205
? no specimens,	395±		1600±

There seems to be no record of the actual depth of this well, nor of the character of the lower rocks drilled through; but it must have gone to the salt-water sand as it was finally abandoned on account of much water and no gas.

J. M. Guffey & Co. well No. 1.

Drilling Jan. 1885.

On Reel Bros. farm, Spence Run, Ross township, Allegheny county, about 1½ miles northerly from Belleview station on the P. F. W. & C. R. R.

Authority J. M. Guffey.

Well mouth 200′ above Belleview sta. . . .				**=728+200=928**
Conductor, ...	**12**	**to**	**12**	**916**
?	**58**	**"**	**70**	**858**
Red shales, ...	**70**	**"**	**140**	**788**
? (850′ of 8 inch casing inserted).	**300**	**"**	**440**	**488**
Coal, ...	**½**	**"**	**440½**	**487½**
?	**189½**	**"**	**630**	**298**
"Boulder" (36 hours drilling 4′), ...	**4**	**"**	**634**	**294**
? (strong gas immediately under Boulder),	**141**	**"**	**775**	**153**
SS. "70′ Rock" (8 days drilling through it),	**70**	**"**	**845**	**+ 83**
SS. solid & uniform drilling, ...	**355**	**"**	**1200**	**— 272**
Slate, good drilling, ...	**220**	**"**	**1420**	**— 492**
"1st Sand" (salt water rose to within 140′ of top), ...	**120**	**"**	**1540**	**— 612**
Shelly, hard, (Put in 1576′ of 5⅝ inch casing),	**110**	**"**	**1650**	**— 722**
SS. oil show (Salt water flowed over casing head), ...	**90**	**"**	**1740**	**— 812**
Hard bluish rock, ...	**40**	**"**	**1780**	**— 852**
Shells, some gas, ...	**20**	**"**	**1800**	**— 872**
Slate, ...	**10**	**"**	**1810**	**— 882**
SS. white, (oil show), ...	**50**	**"**	**1860**	**— 932**
Slate, (depth Jan. 20th 1885), ...	**130**	**"**	**1990**	**—1062**

Pittsburgh Bessemer Steel Co.'s well.

July 1885.

On property of P. B. S. Co. near Homestead, Allegheny Co. Pa. Authority, the Company's record as rendered by W. C. Marr, contractor.

Well mouth above ocean in feet, about, ...				**785**
Conductor, ...	**50**	**to**	**50**	**735**
Shale, hard, ...	**73**	**"**	**123**	**662**
Slate, sandy, ...	**2**	**"**	**125**	**660**
Coal, ...	**2**	**"**	**127**	**658**
Mixed sand, (salt water & gas which soon exhausted), ...	**13**	**"**	**140**	**645**

SS. "mottled" (probably meaning white & dark mixed),		50	"	190	595
Slate & sand,		10	"	200	585
" & " red,		5	"	205	580
Shale, lead color,		35	"	240	545
SS. light gray,	40	60	"	300	485
" white, hard,	20				
Sandy shale,		18	"	318	467
SS. white, "mottled,"		49	"	367	418
Slate,		13	"	380	405
SS. brownish,	60	78	"	458	327
" dark gray,	18				
Coal,		7	"	465	320
SS. & slate. (8⅝ casing to 485),		35	"	500	285
SS. gray, coarse,		18	"	518	272
Slate,		7	"	520	265
SS. white & dark-gray, soft,		10	"	530	255
Slate & sand,		20	"	550	235
Coal,		10	"	560	225
Slate, dark,		27	"	587	198
SS. white, "mottled" (salt water rose to 75′ from top),		13	"	600	185
Slate, dark,		8	"	608	177
SS. white,	6	32	"	640	145
" fine, "mottled,"	26				
Sandy shale,		10	to	650	185
Slate,		10	"	660	125
Sand & shale,		50	"	710	75
SS. white, "mottled,"	10	40	"	750	35
" darker " S. water sp. gr 1.08,	7				
" very dark mottled,	23				
Shale, black,		12	"	762	23
Sand & shale, "mottled,"		10	"	772	13
SS. white "mottled,"		8	"	780	+ 5
Shale, dark (5⅜″ casing to 799′		47	"	827	— 42
SS. & shale mixed,		3	"	830	— 45
SS. gray & white, (limestone, see note below),		45	"	875	— 90
SS. white, fine,		33	"	908	—123
Sandy shale & pyrites,		17	"	925	—140
SS. gray,	10	222	"	1147	—362
" dark gray,	13				
" white, "mottled,"	30				
" gray, coarse, pyrites. gas pocket,	3				
" " hard,	19				
" white, hard,	15				
" dark, coarse,	5				
" white,	30				
" " "mottled,"	10				
" " " coarse,	18				
" gray & white mixed, coarse gas puff,	22				
" white, fine,	25				
" " coarse,	22				

Shale,		7 " 1154	—369
Slate,		11 " 1165	—380
Shale, sandy,		10 " 1175	—390
Sand, shaly,		5 " 1180	—395
SS. gray,		40 " 1220	—435
Sandy shale,		17 " 1237	—452
SS. gray, hard,	13	103 to 1340	—555
SS. white "	90		
Sand and shale,		15 " 1355	—570
Shale bottom sandy, dark,		80 " 1435	—650
Slate,		10 " 1445	—660
SS. white & dark mixed,	8	45 " 1490	—705
" white (salt water sp. gr. 1.11),	18		
" " finer,	4		
" dark,	20		
Slate,		30 " 1520	—735
Shale, sandy,		10 " 1530	—745
SS. gray, mixed,	15	105 " 1635	—850
" white, mottled; large flow of salt water from well, Sp. gr. 1.085—	75		
SS. dark, fine,	10		
" " mixed,	5		
Slate, sandy on top ($4\frac{1}{4}$ casing to 1650'),		25 " 1660	—875
SS. gray & dark mixed,	38	50 " 1710	—925
" mixed,	12		
Slate gritty,		2 " 1712	—927
SS. gray & dark mixed,		24 " 1736	—951
SS. gray & white, medium, (gas at 1736'—9"),		8 " 1744	—959
Total depth (94' of $4\frac{1}{8}$ hole),		1744	—959

With an open vent through a pipe one quarter of an inch in diameter this well maintains a steady pressure of 75 lbs. per square inch.

NOTE.—By examining the specimens I found that the place of the Siliceous limestone was between 795' and 875'. The record should have been:

Slate, dark,	15 to 795
Limestone, dark, shaly,	32 " 827
" siliceous,	48 " 875

This limestone is almost always recorded by the drillers as sand. [J. F. C.]

Munhall & Smithman Well.

July 1881.

Located on the farm of M. Snodgrass, Dirty Camp run, about one mile southeast of Monroeville, Patton township, Allegheny Co.

Authority Mr. Munhall.

Well mouth above ocean in feet, (barometer),					**945′**
Conductor,		**8′**	**to**	**8′**	**937**
Slate,		**60**	**"**	**68**	**877**
Coal,		**2**	**"**	**70**	**875**
Slate and sand,		**15**	**"**	**85**	**860**
" dark,		**35**	**"**	**120**	**825**
"		**20**	**"**	**140**	**805**
Red rock,		**50**	**"**	**190**	**755**
Slate,		**34**	**"**	**224**	**721**
" black,		**141**	**"**	**365**	**580**
SS. white,		**20**	**"**	**385**	**560**
Slate, dark,		**39**	**"**	**424**	**521**
SS. dark,		**20**	**"**	**444**	**501**
Coal		**4**	**"**	**448**	**497**
Slate,		**42**	**"**	**490**	**455**
Coal blossom and black slate,		**4**	**"**	**494**	**451**
SS.		**16**	**"**	**510**	**435**
Slate, black; with coal blossom,		**60**	**"**	**570**	**375**
Coal,		**5**	**"**	**575**	**370**
Slate,		**35**	**"**	**610**	**335**
SS. sharp (cased at 630′),	**20**	**50**	**"**	**660**	**285**
" gray,	**30**				
Slate, black,		**45**	**"**	**705**	**240**
" soft,		**35**	**"**	**740**	**205**
SS. gray,	**20**	**40**	**"**	**780**	**165**
" white,	**20**				
Slate, black,		**45**	**"**	**825**	**120**
SS. white, fine,		**100**	**"**	**925**	**+ 20**
Slate and shells, dark,		**20**	**"**	**945**	**00**
SS.		**30**	**"**	**975**	**— 30**
" hard,		**125**	**"**	**1100**	**—155**
Slate and shells,		**30**	**"**	**1130**	**—185**
SS. gray and white,	**100**	**260**	**"**	**1390**	**—445**
" white,	**75**				
" gray,	**40**				
" mixed, pepper and salt sand,	**45**				
Hard shells and dark sand,		**21**	**"**	**1411**	**—466**
Slate and shells, (little gas,)		**89**	**"**	**1500**	**—555**
" soft,		**60**	**"**	**1560**	**—615**
Sand and shale,		**57**	**"**	**1617**	**—672**
Soft slate and shells, (fresh water at 1696′,)		**79**	**"**	**1696**	**—751**
SS. white, pebbles, (flood of fresh water at 1705′,)		**102**	**"**	**1798**	**—853**
Total depth of well,				**1798**	**—853**

"The first 8 feet of the 102 foot sand was coarse and white, then came 15′ of the best pebble sand I ever saw, but full of fresh water. The water ran over the top of the casing at the rate of 4000 barrels in 24 hours. The sand got finer on each bit run, until at the last, it was as fine as emery."

Munhall & Smithman well.

Jan. 1882.

On the Sherrich farm, Jacks Run, ¼ of a mile east of Jack's Run school house, in the northeast part of South Versailles township, Allegheny county. Authority, Mr. Munhall.

The Crinoidal limestone is exposed about 15′ above the well.

Well mouth above ocean in feet, (barometer,)					875
Slate and soft rock,		80	to	80	=795
" black, and red rock,		80	"	160	715
SS. gray, coarse,		40	"	200	675
Slate, black, and shells,		55	"	255	620
SS. gray,		15	"	270	605
Slate, (salt-water,)		20	"	290	585
"		32	"	322	553
Coal.		5	"	327	548
Slate, black,		63	"	396	486
SS. white,		20	"	410	465
Slate,		60	"	470	405
Coal,		6	"	476	399
SS. mixed, hard, (little gas.)		24	"	500	375
Slate and hard shells,		12	"	512	363
SS. white, fine,		78	"	590	285
" and slate, (salt-water and gas,)		40	"	630	245
Slate, with 2′ of coal,		30	"	660	215
SS. dark,		17	"	677	198
Slate,		24	"	701	174
SS. white,		29	"	730	145
" (salt-water,)		15	"	745	130
Sand and slate,		22	"	767	108
Slate and shells,		94	"	861	+ 14
SS. white, (cased at 932′.)		71	"	932	— 57
" " (little gas,)		268	"	1200	— 325
" gray,		15	"	1215	— 340
Slate,		115	"	1330	— 455
" and sand,		70	"	1400	— 525
Sand and slate,		87	"	1487	— 612
SS. white,	7	31	"	1518	— 643
" and gray,	24				
Slate, black and shells,		66	"	1584	— 709
SS. white, (fresh water,)	16	111	"	1695	— 820
" " pebbly,	10				
" " coarse,	60				
" " fine,	25				
" red, with little slate,		10	"	1705	— 830
Slate, soft at bottom,		19½	"	1724½	— 849½

The flow of fresh water at 1600′ was 3500 bbls. in 24 hours.

[In May, 1883, I visited this well. It was flowing heavily, making 26 pulsations per minute. The water was tepid, slightly brackish, or charged with soda, like the Wall station well, and the gas had an offensive smell, like bilge-water, without the least odor of petroleum. J. F. C.]

Wall Station well.

1882.

In North Versailles township, Allegheny county, about 50′ south of the railroad track, and 150′ east of the depot, at Wall station on Penna. R. R. Drilled for the R. R. company by Milor & Sutton. Facts ascertained from man in charge of well.

Well mouth above ocean (say 9′ above depot), = ...	**760**
Present water flow from, ...	**1810′**
Depth of well, ...	**1850**

Salt water struck and cased off before the present flow was encountered.

The well flows about 1500 barrels per day.

The water is supposed to be charged with soda.

It is soft and excellent for washing purposes, but unfit for use in steam boilers.

Gas enough to light 200 jets for making lamp black.

[The water has a temperature of probably 65° or 70° F. and the gas coming with it burns with a rich, dark flame, but smells sulphury and has none of the peculiar odor belonging to petroleum gases.]

Irwin Station well.

A well was put down at Irwin Station, Penn township, Westmoreland county, in 1884, which got water similar to that at Walls, but it only rises to within 200′ of the surface.

Say well No. 5.

May, 1886.

At Sandy Creek, Penn township, Allegheny Co. Owners, the Wildwood Oil Co. Authority, the driller's book.

Well mouth above ocean in feet,			?
Clay,	8	to	8
Gravel,	4	"	12
Gray slate,	58	"	70
" sand,	12	"	82
Blue slate,	100	"	182
Gray sand,	25	"	207
" slate,	35	"	242
Black "	43	"	285
Gray "	85	"	370
" sand,	25	"	395
Gray slate,	75	"	470
Black sand, (gas and salt water,)	10	"	480
Gray, "	20	"	500
Black slate,	130	"	630
White sand,	10	"	640
Black slate,	60	"	700
Gray sand, hard,	10	"	710
Black "	10	"	720
White "	30	"	750
Black slate,	15	"	765
White sand, hard,	10	"	775
Black slate,	10	"	785
Red rock,	25	"	810
Gray sand,	10	"	820
Red rock,	5	"	825
Gray sand,	75	"	900
White sand,	200	"	1100
Gray sand,	230	"	1330
Black slate,	140	"	1470
Gas sand,	17	"	1487
Black slate,	58	"	1545
Salt water sand,	115	"	1660
Slate, (cased at 1673',)	13	"	1673
Slate,	47±	"	1720±
SS.	30±	"	1750±

Unproductive.

Black well.

Drilling Jan. 15, 1885.

On the J. B. Soles farm, South Versailles township, about a mile southwest from the Weston well.

Dr. Black refuses to give record, but it is evident that the salt water sand has been passed—the salt water cased off, and they are now drilling 200′ or more below, without having developed anything more promising than the other wells in that township.

Bissell well.

Sept., 1884.

Located on the division line between Bissell farm and Lemon farm, on Long run, in South Versailles township, Allegheny Co., and about one mile north of Elrod well. Authority, Wm. Johnston.

A good flow of gas at 1490′, which gradually exhausted in about 60 days; when drilling was resumed. After drilling a few feet, salt water was struck and at 1510′ the well being flooded with water, it was abandoned. Well mouth above ocean 775′±.

Vandergrift or Erschman well.

March, 1884.

Located on the Shaw farm, near Sampson's mill, in South Versailles township, Allegheny county, eight hundred feet west of the junction of Jack's Run, with Long Run, and about 3 miles northeast of Elrod well. Authority, Wm. Johnson.

Well mouth above ocean	840′
Depth of well, (say 1′ in the sand) about	1550′
A show of oil is reported at	750′

The well is now flowing about 40 bbls. of salt water per day, with a considerable volume of nearly odorless gas, which, as far as can be judged, has weakened but little since the well was opened.

Weston well.

Nov. 10, 1884.

Located on the Pauline Auberle farm, in South Versailles township 750′ southwest of the Vandergrift well. Drilled for the Youghiogheny Natural Gas Company by William Johnston. Record from memory.

Well mouth above ocean	925′
Coal 6′ thick at	275′
Cased with 7⅝ casing at	400
Little salt water at	435
Much salt water, very salt and quickly rose to within 50′ of the surface, at	750
Cased with 5⅜ casing at	912

Salt water, which exhausted by bailing, at	1250′
Little oil, gas in 1¼′ pebble shell at 1614′	1614′
Struck salt water sand at	1622′
Well filled to within 200′ of top and abandoned at	1624

The gas smells very oily, but the supply is too small to be of any practical value.

Munhall well.

1886.

At Wallace station, B. & O. R. R., Jefferson township, Allegheny Co. Authority, Wm. Munhall.

Well mouth above ocean in feet, about				870
Conductor,	26	to	26	844
Slate and shells,	140	"	166	704
Streak of coal,	4	"	170	700
Slate and shell,	56	"	226	644
SS. gray,	80	"	306	564
Slate and shell,	94	"	400	470
SS. gray,	28	"	428	442
Slate,	20	"	448	422
SS. white,	60	"	508	362
Slate,	50	"	558	312
SS. gray,	80	"	638	232
Slate,	15	"	653	217
SS. gray (water,)	97	"	750	120
Slate and shells,	15	"	765	105
SS. white, (gas,)	45	"	810	60
Slate,	5	"	815	55
SS. white (water,)	30	"	845	+ 25
Slate, black,	100	"	945	— 75
SS. white,	25	"	970	— 100
Slate,	50	"	1020	— 150
White sand,	280	"	1300	— 430
Slate and shells,	143	"	1443	— 573
SS. white,	20	"	1463	— 593
Slate, shells and sand,	359	"	1822	— 952
SS. gray,	15	"	1837	— 967
Slate black,	15	"	1852	— 982
Slate and brown sand,	87	"	1939	—1069
Sand, gray, (showing of gas,)	3	"	1942	—1072
Slate, shells, and brownish sand,	72	"	2014	—1144

Hukill well.

July 29, 1883.

On a westerly tributary of Pine creek, J. C. Bryant farm, about ½ mile south of the north line of Shaler twp., Allegheny co. Authority, E. M. Hukill.

Well mouth above ocean in feet, (barometer),					1010
Conductor,		6	to	6	1004
Limestone, about,		3	"	9	1001
Slate,		21	"	30	980
SS. coarse,		40	"	70	940
Fire clay and layers of sand,		120	"	190	820
SS.,		70	"	260	750
Coal,		5	"	265	745
Slate,		45	"	310	700
SS. dark,		40	"	350	660
Slate and shells,		20	"	370	640
SS. dark,		7	"	377	633
Slate and shells,		13	"	390	620
SS. dark, 7 " white, 10 " dark, 5 " salt water and some gas 20 " 55	Mountain Sand,	97	"	487	523
Coal,		5	"	492	518
SS. hard (cased at 510′),		25	"	517	493
" white and dark,		116	"	633	377
" white,		47	"	680	330
" dark,		25	"	705	305
" white, coarses at bottom,		165	"	870	140
" gray,		20	"	890	120
Slate and shells,		55	"	945	65
SS. gray, some gas,		5	"	950	+ 60
" white,		70	"	1020	— 10
Sand and shells,		30	"	1050	— 40
Slate and shells,		110	"	1160	—150
SS. gray,		15	"	1175	—165
Sand and slate,		90	"	1265	—255
Sandy shells,		20	"	1285	—275
SS. white—salt water,		93	"	1378	—368
Slate, to bottom,		15	"	1393	—383

In the last sand the well filled up with salt water which flowed over the casing head at the rate of over 1,500 barrels per day, and as there was no gas, the well was abandoned.

CHAPTER IX.

Well Records in Washington County.

McGuigan Gas well, No. 1.

Completed 1882.

On H. McGuigan's farm, Mount Pleasant township, 6¾ miles S. S. E. of Burgettstown, and 2½ miles S. W. of Hickory P. O. On a branch of Cross Creek above the W. township line. Owners, The Niagara Oil Company of Buffalo. Authority, F. Crocker.

Well mouth above ocean in feet (barometer), .				1175
?	180	to	180	995
Coal, ...	5	"	185	990
?	100	"	285	890
Coal, ...	15	"	300	875
? (Red at 470, Limestone at 725, sand at 730), . .	462	"	762	413
SS. "1st Sand,"	40	"	802	373
?	63	"	865	310
SS. "2nd Sand,"	35	"	900	275
?	20	"	920	255
Brown sand, thickness not given, at, ...			920	255
? (Shell at 982), ...	68	"	988	187
SS. "3rd SS." (little gas), ...	40	"	1028	147
?	72	"	1100	75
SS. "4th SS." dark (show of amber oil)	55	"	1155	+ 20
?	111	"	1266	— 91
SS. "5th SS." (15′ slate at 1350, oil show at 1372)	234	"	1500	— 325
?	78	"	1578	— 403
SS. "6th SS."	10	"	1588	— 413
?	262	"	1850	— 675
SS. "7th SS." "small sand" say, ...	5	"	1855	— 680
? (Red rock at 1965, Soapstone at 1995), ...	180	"	2035	— 870
SS. "8th SS."	10	"	2045	— 860
?	192	"	2237	—1062
SS. "Gas sand" not through, ...	8	"	2245	—1070

Mr. Robbins, the general manager of the company, says the well was cased as follows:

700' ± of 5⅝ inch casing.
900 ± " 4¼ inch "
1020 ± " 3⅜ inch "
And a 2½ inch hole was drilled from 1020' to the bottom.

A very large gas well. See Ford & Nelson's gas line. This was the first large gas well struck in Washington county.

Buchanan well.

Completed 1883.

On J. S. Buchanan farm, Cross Creek township, 6½ miles south of Burgettstown, Washington county, 2¾ miles west of McGuigan well No. 1, (on the same branch of Cross creek) and two miles below Woodrow P. O. Owners, Niagara Oil Company. Authority, F. Crocker.

Well mouth above ocean in feet,			
Interval not described,			287
Coal at,			278
Interval,	172	to	450
Red rock at,			450
Interval,	167	"	617
Brown sand at,			617
Interval,	58	"	675
Gray limestone at,			675
Interval,	11	"	686
Sandstone at,			686
Interval,	29	"	715
First sand at,			715
Intervl (Cased at 762),	198	"	913
Second sand (Coal blossom at 1190),	514	"	1427
Interval (Cased at 1450' with 4¼ casing),	200	"	1627
Sand at,			1627
Interval,	283	"	1910
Sand at,			1910
Interval,	90	"	2000
Red rock at,			2000
Interval,	90	"	2090
Sand and gas at,			2090
Interval,	170	"	2260
Sand gas and little oil,			2260
Interval,	232	"	2492
Red rock at,			2492
Interval,	333	"	2825
Brown sand at,			2825
Interval,	230	"	3055
Sand at,			3055
Interval,	545	"	3600
Oil sand—shell at,			3600

Interval,	**150**	**''**	**3750**
Sand at,			**3750**
Interval,	**210**	**''**	**3960**
Red rock at,			**3960**
Interval,	**50**	**''**	**4010**
Soapstone at,			**4010**
Interval,	**150**	**''**	**4160**
Sand at,			**4160**
Interval,	**143**	**''**	**4303**
"Bradford Sand" at,			**4303**

The above record is fragmentary and unsatisfactory, but comparing it with the McGuigan well, the coals, red rocks, limestones and sandstones have some correspondence, and there seems to be little doubt that the sandstone (with gas) at 2260′ represents the McGuigan gas sand. The drill descended over 2000 feet below this sand and is said to have stopped in the top of the Bradford sand–the tools having been hopelessly stuck in the hole. This is evidently a mistake. It is generally understood that the Bradford sand lies about 1000 feet below the Venango Oil group. It also seems quite clear that the McGuigan gas sand represents one of the lower members of that group. Therefore, the bottom of the well is certainly many hundred feet below the place where the Bradford sand should be looked for.

Rush well.

Completed Sept. 17, 1884.

On John Rush farm Hopewell twp., 10 miles S. by W. from Burgettstown, 5 miles S. W. of McGuigan Well No. 1, and 1½ miles southeasterly from West Middletown, on a branch of Buffalo creek. Authority, Mr. C. D. Robbins.

Elevation of well mouth,			**?**
Conductor,	**35**	**to**	**35**
Coal,	**5**	**''**	**40**
Limestone,	**263**	**''**	**303**
***Coal* blossom,**	**5**	**''**	**308**
Slate,	**50**	**''**	**358**
***Coal* blossom,**	**5**	**''**	**363**
Slate and shale,	**137**	**''**	**500**
Sand shells,	**25**	**''**	**525**
Red rock,	**190**	**''**	**715**
Slate, black (water),	**30**	**''**	**745**
Soapstone,	**90**	**''**	**835**

SS. No. 1 (salt water and gas),	65	"	900
Slate and shale,	25	"	925
SS. No. 2,	195	"	1120
Slate and sandstone,	185	"	1305
SS. (salt water and some gas),	40	"	1345
Slate,	25	"	1370
Coal,	10	"	1380
SS. brown,	40	"	1420
Slate and sandstone,	35	"	1455
SS. brown,	8	"	1463
SS. very hard drilling,	75	"	1538
Slate, very hard drilling,	10	"	1548
Coal blossom,	10	"	1558
Slate and shells,	60	"	1618
Soapstone,	110	"	1728
Slate and shells,	102	"	1830
Shells, pebbly, (gas pocket),	5	"	1835
Slate,	50	"	1885
Shale and slate,	100	"	1985
Shells,	5	"	1990
Slate,	80	"	2070
Shale,	17	"	2087
Shells, oily,	20	"	2107
Shale and slate,	25	"	2132
Soapstone,	30	"	2162
Red rock,	80	"	2242
Soapstone,	15	"	2257
Stray sand, dark,	6	"	2263
Shells and slate,	30	"	2293
Shale,	15	"	2308
Red rock,	10	"	2318
Soapstone,	30	"	2348
Shale and slate,	50	"	2398
Soapstone,	40	"	2438
Shells,	10	"	2448
Slate,	50	"	2498
Shale and slate,	60	"	2558
Stray sand,	10	"	2568
Slate,	40	"	2608
Shale, blue,	35	"	2643
Red rock,	70	"	2713
SS.,	8	"	2721
Shale,	40	"	2761
Soapstone,	60	"	2821
Slate,	50	"	2871
Red rock,	60	"	2931
Slate,	40	"	2971
Slate, sandy,	14	"	2985
Shells,	10	"	2995
SS. oily,	15	"	3010
Slate,	100	"	3110
Shells and slate,	90	"	3200

Soapstone,	40	"	3240
Slate,	60	"	3300
Shale and slate,	80	"	3380
Soapstone,	30	"	3410
Slate,	25	"	3435
Limestone,	20	"	3455

Cased with 7⅝ casing at about 720′
" " 5⅝ " " " 925′
" " 4¼ " " " 1465′
4⅛ inch hole to bottom.
No oil, no gas, abandoned.

Emery Gas well.

Completed April, 1884.

On E. G. Emery farm, Mount Pleasant township, 6 miles S. E. of Burgettstown, 1½ miles northeast of McGuigan well No. 1, and 1¼ m. West of Hickory P. O.

Well mouth above ocean (Aneroid),	1200′
Depth of well, (cased at about 900),	1151′

A very large gas well. A pipe line is now being laid (Jan. 1, 1885), to convey the gas from this well and the Miller well to Pittsburgh.

Miller Gas well.

Completed July, 1884.

On J. M. Miller's farm, Mount Pleasant township, 3¼ miles north-easterly from McGuigan well No. 1, and ¾ m. E. of Hickory. Authority, Gibson & Giles, contractors.

Well mouth above ocean (Aneroid),				1135
Conductor,	8′	to	8′	1127
Limestone, solid, no shale,	177	"	185	950
Coal "Pittsburgh,"	10	"	195	940
Shale and layers of sand,	100	"	295	840
SS. "70 ft. rock,"	70	"	365	770
Slate and shale and some thin sands,	255	"	620	515
SS. some salt water,	20	"	640	495
Slate and shells,	170	"	810	325
SS. white; salt water,	40	"	850	285
Slate (cased with 5⅝ casing at 912),	62	"	912	223
Slate,	143	"	1055	80
SS. not through—heavy gas,	5	"	1060	+75

The well was first cased at 390′ in a red shale, from 30′ to 50′ thick. After salt water was struck at 625′ the red shale caved and the casing was drawn and a ten inch hole for 7⅝ inch casing reamed down to 550′; from this point the diameter is 7⅝ inches down to 912′, where 5⅝ inch casing was inserted. Below this the well was perfectly dry. The gas came in force as soon as the top shell of the sandstone was pierced. Mr. Giles says it is the purest, dryest gas he has any knowledge of, and that it has a sweetish but not an oily odor. I could not detect the least smell of gas about the well although I examined very carefully every place where a little leak was likely to occur.

This is a stronger well than the Emery which is located about 2 miles to the west and half a mile to the south. One main will conduct the gas from these two wells to Pittsburgh.

Scott well.

Completed Nov. 25, 1884.

On J. L. Scott farm, Cecil township, 6 miles N. E. of McGuigan well No. 1, one mile N. W. of Venice and ¼ m. from W. township line.

Authority, Gibson & Giles, contractors.

Well mouth above ocean (aneroid),				1055′
Conductor, to limestone,	6′	to	6′	1049
Limestone and slate, broken rock,	119	"	125	930
Coal,	6	"	131	924
Slate and shale, inclined to cave,	166	"	297	758
SS. "70 ft. rock,"	50	"	347	708
Shales and some sandstone,	293	"	640	415
Coal,	11	"	651	404
Sand and shale,	156	"	807	248
Coal,	3	"	810	245
SS. (much salt water,)	40	"	850	205
Slate and shells,	200	"	1050	+5
SS. white, fine, hard,	104	"	1154	—99
Slate and shells,	96	"	1250	—195
SS. hard, "Mountain Sand,"	150	"	1400	—345
Slate and shells, hard; some SS. layers 10′ thick,	596	"	1996	—941
SS. open, porous (little gas),	16	"	2012	—957
Slate and shells,	186	"	2198	—1143
SS. brown; "like Bradford sand" (oil show)	12	"	2210	—1155
Slate,	1	"	2211	—1156
SS. white, gas and salt water,	25	"	2236	—1181
Slate to bottom,	11	"	2247	—1192

Cased at 347′ with 7⅞ in. casing; at 1158′ with 5⅝ in. casing. When the last sand was struck, the well filled up with salt water 1500′ while one bit was being run. The water is strong and bitter; Mr. Giles says the well flows at intervals of about 40 minutes, throwing out from 5 to 10 bbls. of salt water with a trace of oil at each flow. The volume of gas is small.

Donaldson well.

Drilling, Jan. 1, 1885.

On J. M. K. Donaldson farm, Mount Pleasant township, about 1¼ miles E. N. E. of McGuigan well No. 1, and 1¼ miles S. W. of Hickory. Authority, Gibson & Giles, contractors.

Well mouth above ocean (aneroid),				**1145′**
Conductor,	**16**	**to**	**16**	**1129**
Limestone and slate,	**149**	**''**	**165**	**980**
Coal,	**6**	**''**	**171**	**974**
Limestone and shale,	**344**	**''**	**515**	**630**
SS. (salt water),	**20**	**''**	**535**	**610**
Slate and shale,	**165**	**''**	**700**	**445**

Large flow of gas obtained Jan. 10, 1885.

Carlisle well.

Drilling, Jany. 1, 1885.

On John Carlisle farm at Hickory, Mount Pleasant township, 2¾ miles N. E. of McGuigan well No. 1, and ½ a mile westerly from the Miller well.

Well mouth above ocean (Aneroid), ... 1235

This made a good gas well.

Hess Gas well No. 1.

April 29, 1884.

Located on the Hess farm, Canton township, about a mile and a quarter N. N. W. from the Chartiers R. R. depot at Washington, Washington county. Owners, The Washington Light and Heat Co. Record given by Gibson and Giles, contractors.

Well mouth above ocean in feet (barometer),				**1005**
? (Salt water and gas at 170′),	**242**	**to**	**242**	**763**
Coal, Pittsburgh, seam,	**7**	**"**	**249**	**756**
? (Cased ot 516′),	**616**	**"**	**865**	**140**
Red rock and amber oil at,			**865**	**140**
? (Cased at 900′),	**125**	**"**	**990**	**15**
Coal or coal slate,	**5**	**"**	**995**	**+ 10**
? (Little gas at 1200′),	**390**	**"**	**1385**	**—380**
Bluff sandstone,	**40**	**"**	**1425**	**—420**
?	**30**	**"**	**1455**	**—450**
Mountain sand,	**140**	**"**	**1595**	**—590**
?	**305**	**"**	**1900**	**—895**
SS. very hard,	**5**	**"**	**1905**	**— 900**
?	**145**	**"**	**2050**	**—1045**
"Second sand," gas sand, not through,	**18**	**"**	**2068**	**—1063**

Mr. A. J. Montgomery, a member of the Gas Company has preserved 357 specimens of sand pumpings from this, the first well drilled for gas near Washington. Unfortunately they were put into bottles wet and are now so caked and discolored that they are of little value. A test of some of them with acid disclosed limestone at 330′, 513′, 962′, and 1385′. The latter (at 1385′) is called in the record "Bluff sand." It is siliceous and might easily be mistaken for a sandstone—as indeed it always has been by the drillers. The sand pumpings both above and below this point contain lime, and there can be no question that this is the same lime horizon found in Boyd Hill well in 1876. The Crinoidal lime is underlaid, as shown by the specimens, by the usual band of red and variegated shales.

Hervey Gas well.

Sept., 1884.

Located on the Hervey farm, Canton townsnip, one mile N. E. of the Hess Well. Owners, the Washington Light and Heat Co. Record given by Gibson and Giles contractors.

Well mouth above ocean in feet,				**985**
?	**140**	**to**	**140**	**845**
Coal, Pittsburgh,	**7**	**"**	**147**	**838**
?	**118**	**"**	**265**	**720**
SS. gray,	**110**	**"**	**375**	**610**
? (Cave at 405—Cased 417,)	**181**	**"**	**556**	**429**
Salt-water sand,	**40**	**"**	**596**	**389**
?	**4**	**"**	**600**	**385**

Coal,	8	"	608	377
? (Salt water at 646,)	102	"	710	275
Coal,	3	"	713	+272
? (Salt water at 840. Cased at 850,)	572	"	1285	—300
Bluff sand,	40	"	1325	—340
?	30	"	1355	—370
Mountain sand,	140	"	1495	—510
?	465	"	1960	—975
Gas sand not through,	17	"	1977	—992

A good gas well used in connection with the Hess well to supply the town of Washington with fuel gas.

Canonsburg Gas well.

Nov., 1884.

At Canonsburg Iron works, on Chartiers Creek North Strabane township, Washington County.

Well mouth above ocean, about, ... 930'

Said to be 1800′ deep, and to have struck gas at 1782′.

A small well, but gas enough to be of considerable value if it proves lasting. Used in the Iron Mill.

Gantz well.

Jan. 1, 1885.

Belonging to the Citizens' Natural Gas Company, and located at Gantz's Mill, about 20 rods from the Chartiers R. R. depot at Washington. Authority, W. C. Marr, Contractor.

Well mouth above ocean in feet, (about R. R. level,)				1030
Sandy loam,	10	to	10	1020
Limestone, broken,	20	"	30	1000
Coal and slate, crumbling,	4	"	34	996
Limestone, (Conductor set on this,)	20	"	54	976
Slate and shells,	200	"	254	776
SS. hard, gray,	20	"	274	756
Slate, black,	30	"	304	726
SS. hard,	25	"	329	701
Slate and shells,	4	"	333	697
SS. soft, white,	5	"	338	692
Slate, soft, black,	1	"	339	691
Coal, Pittsburgh seam,	5	"	344	686
SS. soft,	10	"	354	676
Slate,	12	"	366	664
Shell, hard,	2	"	368	662
Slate,	10	"	378	652

SS. hard, gray,		11	"	389	641
Slate.		30	"	419	611
SS. white, soft,		10	"	429	601
Slate,		51	"	480	550
SS. very hard,		80	"	560	470
Slate,		10	"	570	460
Limestone,		5	"	575	455
Slate,		15	"	590	440
Red rock, inclined to cave, (623 of 7⅝ casing,)		60	"	650	380
Slate and shells,		40	"	690	340
Red rock, caving badly,		25	"	715	315
Slate,		32	"	747	283
Red rock,		25	"	772	258
SS. white,		20	"	792	238
Slate and shells,		100	"	892	138
SS. hard, gray,		100	"	992	38
Coal and slate,		12	"	1004	+ 26
Slate and shells,		60	"	1064	— 34
SS.,		20	"	1084	— 54
Slate and shells,		100	"	1184	—154
SS., hard, whitish, (salt water.)		57	"	1241	—211
Slate, black, no grit, (cased at 1246,)		15	"	1256	—226
SS., soft, whitish,		10	"	1266	—236
Slate and shells,		15	"	1281	—251
SS. hard, bluish-gray,		12	"	1293	—263
Slate and shells,		27	"	1320	—290
SS. (good gas but soon exhausted,)		10	"	1330	—300
Slate, black, no grit,		10	"	1340	—310
SS. hard and flinty,		3	"	1343	—313
Slate, black, no grit,		77	"	1420	—390
Limestone,		30	"	1450	—420
SS. hard, white,	90	320	"	1770	—740
" softer, white,	6				
" hard, "	8				
" hard and soft in streaks,	40				
" close, bluish-gray,	20				
" soft and hard in streaks,	140				
" very hard,	16				
Slate, black, no grit,		25	"	1795	— 765
SS. pebbly,		40	"	1835	— 805
Slate and hard shells,		100	"	1935	— 905
SS. hard,		25	"	1960	— 930
" with hard streaks,		40	"	2000	— 970
" soft,		30	"	2030	—1000
" hard,		45	"	2075	—1045
Slate and shells,		40	"	2115	—1085
SS. white, hard, pebbly,		8	"	2123	—1093
Slate, good drilling,		15	"	2138	—1108
SS. blackish, rotten,		10	"	2148	—1118
" brownish red, coffee color,		8	"	2156	—1126
Slate,		15	"	2171	—1141
SS. dark, pebbly,		6	"	2177	—1147

SS. fine, coffee color,	12	"	2189	—1159
SS. (good show of oil and drill stopped,)	2	"	2191	—1161

This was the first paying oil well in Washington county. Sand was struck January 1st, 1885 and the hole filled up about 1200′ with oil. The derrick was then closed and guarded until January 19th, when, tanks having been erected, the well was opened and made about a 50 barrel flow. But as it would only flow spasmodically or upon agitation it was drilled through the sand, torpedoed and pumped, yielding from 15 to 20 barrels per day for several months, after which it was deepened to the "Gordon sand" with some improvement.

When this oil rock was found the drillers did not know what sand of the old districts it represented, and so named it the "Gantz sand," which name is still generally applied to that stratum throughout all the southern districts, although it is now known to be the upper member of the First Oil sand of the Venango Oil group.

Thayer well.

Aug. 1, 1885.

On Farley farm, Washington, Washington Co.

Authority Prof. Linton down to 1717, drillers record below that.

Well mouth above ocean in feet,			?
?	375	to	375
Coal, (Pittsburgh,)	7	"	382
SS.,	65	"	447
Shale, black and red mixed,	70	"	517
" red,	30	"	547
Limestone,	5	"	552
SS. fine; Salt water, (Morgantown SS.,)	50	"	602
Shale, black,	25	"	627
" variegated,	60	"	687
SS. hard,	20	"	707
Shale, black,	37	"	744
SS. fine grained,	17	"	761
Shale, variegated, (red mud,)	34	"	795
SS. fine, slaty, flaggy,	71	"	866
Shale, olive green,	4	"	870
SS. gray, fine, flaggy,	15	"	885
" white,	17	"	902
Shale, dark and light, trace lime at bottom,	40	"	942

SS. dark,		36	"	978
" white,		16	"	994
" dark, with limestone,		4	"	998
" " hard,		19	"	1017
Shale, dark,		28	"	1045
" variegated, with dark limestone,		8	"	1053
Limestone, { dark 3, light 8, }		11	"	1064
Shale, dark, slaty,		30	"	1094
" and coal, (Coal 3,)		6	"	1100
Shale, slate and shells,		30	"	1130
SS. grayish, compact,		26	"	1156
Shale, gray, compact,		11	"	1167
SS. grayish, slaty,		29	"	1196
Shale and sand shells,		19	"	1215
SS. fine, gray,	9	87	"	1302
" white, micaceous,	32			
" white and dark, mixed,	17			
" white, fine,	29			
Coal,		1½	"	1303½
SS. white, hard, (Salt water at 1330: Cased at 1360,)		66½	"	1370
SS. fine, white and dark,		15	"	1385
Shale, very dark, hard shells,		13	"	1398
SS. white, fine,		10	"	1408
Shale, black,		4	"	1412
SS. white, fine,		2	"	1414
Black shale and coal,		2	"	1416
SS. close grained,		1	"	1417
Shale and slate,		13	"	1430
Shale and shells,		15	"	1445
Shale, black and dark-gray,		35	"	1480
Limestone and shale,		27	"	1507
" white, hard, silicious,		58	"	1565
SS. gray, coarse,	23	120	"	1685
" white,	97			
Slaty shale, black,		2	"	1687
SS. white,		30	"	1717
?		473	"	2190
SS. white, (gas at 2200,)		20	"	2210
Slate,		4	"	2214
SS. white, (pebbles and strong gas at 2225,)		16	"	2230
Slate,		15	"	2245
SS. white, (oil at 2260,)		35	"	2280
Slate to bottom,		5	"	2285

A strong gas well.

Gordon well No. 1.

Aug. 21, 1885.

On the Gordon Farm, about one mile northwest of the Gantz well at Washington, Washington Co. Owners the Washington Light and Heat Co.

Well mouth above ocean in feet about,				1005
?	305	to	305	700
Coal,	5	"	310	+ 695
? (580′ of $7\frac{1}{8}$ casing and 1800′ of $5\frac{1}{8}$,)	1084	"	1394	— 389
Limestone,	18	"	1412	— 407
Big Sand, one screw of slate in it,	258	"	1670	— 665
? (1680′ of $4\frac{1}{4}$ casing.)	443	"	2113	—1108
Gas sand or Gantz sand,	43	"	2156	—1151
White sand,	50	"	2206	—1201
Red sand,	5	"	2211	—1206
Blue shale and gray sand, with red sand at base,	107	"	2318	—1313
Pebble sand,	15	"	2333	—1328
Hard sand,	9	"	2342	—1337
Gray pebble sand, (stray,)	12	"	2354	—1349
Slate and shells,	38	"	2392	—1387
Gordon sand, top, (Wire measure,)			2392	—1387
SS. "Gordon sand,"	16	"	2408	—1403

The Gordon well was located by the Light and Heat Company, about 200 rods southwest from its pioneer well on the Hess farm, for the purpose of obtaining an increase of gas to satisfy the demands upon its pipe lines. Failing to get a good flow in the rock corresponding with the Hess sand, it was drilled deeper in hopes of finding a better supply in the horizon of the McGuigan gas sand. The result was the discovery of the so-called "Gordon Sand," and the striking of an oil well, which started off, naturally, with a production of over 100 barrels per day. Active oil developments in Washington county commenced with the opening of this well.

Reed Farm well.

1886.

Owned by the Associated Producers Co. at Washington, Washington Co. From the company's books.

Well mouth above ocean in feet.			
?	260	to	260
Pittsburgh coal,	5	"	265
?	595	"	860
Coal at,		"	860
? (Salt water at 940: gas at 2140,)	1287	"	2147
Gantz sand at,			2147
?	343	"	2490
SS. "fairly good,"	24	"	2514
?	85	"	2599

Triangle well.

1886.

Curry lot, Washington—Owners, Associated Producers Co. From the company's books.

Well mouth above ocean in feet.

?	350	to	350
Pittsburgh coal,	5	"	355
? (Caved at 630′. Salt water 1300′ and 1635,)	1805	"	2160
Gantz sand at,			2160
SS. and a little slate,	45	"	2205
"50 feet rock," (gas and oil at 2240,)	90	"	2295
?	90	"	2385
Stray sand,	36	"	2421
?	7	"	2428
Gordon sand, (gas and oil at 2431,)	16	"	2444

Vandergrift well No. 1.

Feb., 1886.

On the Weirich farm, one and a half miles west of Washington, Washington Co. Owner J. J. Vandergrift. Authority, A. W. Wolf, contractor.

Well mouth above ocean in feet, ?

Conductor, (limestone soil,)	17	to	17
Limestone,	5	"	22
Slate, white,	3	"	25
Limestone,	12	"	37
SS.,	5	"	42
Limestone,	20	"	62
Slate,	40	"	102
Limestone,	15	"	117
Slate, white,	20	"	137
Limestone, dark,	30	"	167
" white,	50	"	217
Coal blossom,	1½	"	218½
Slate, black,	5	"	223½
SS. dark-gray,	11½	"	235
Slate, black,	4	"	239
Limestone, hard,	12	"	251
Slate, white,	3	"	254
Limestone, hard,	20	"	274
Slate, white, tough,	25	"	299
SS. white, hard,	20	"	319
Slate, black,	5	"	324
Pittsburgh coal blossom—no coal,	6	"	330
Limestone, hard,	11	"	341
Slate, white,	15	"	356
SS. hard,	60	"	416

Slate, white,	20	to	436
SS. gray, hard,	12	"	448
Red rock, 1st cave,	20	"	468
Limestone, dark, very hard,	5	"	473
Red rock, 2nd cave,	20	"	493
SS.,	30	"	523
Slate, white, and sand; this caves,	40	"	563
Red rock No. 3—caves,	3	"	566
Slate, white. caves,	12	"	578
Red rock, very bad cave,	26	"	604
SS. hard,	10	"	614
Red rock and caves,	6	"	620
Slate, white and black,	94	"	714
Sand and slate mixed,	83	"	797
SS.,	50	"	847
Slate,	12	"	859
SS.,	100	"	959
SS. and slate,	25	"	984
Slate,	63	"	1047
Slate, white and black,	100	"	1147
SS.,	40	"	1187
Slate,	30	"	1217
SS. loose, (Top of "Big Injin,")	23	"	1240
SS. very hard,	50	"	1290
SS. loose,	10	"	1300
Slate,	5	"	1305
SS. hard (Big vein odorless gas, exhausted in 3 days,)	5	"	1310
SS. hard,	25	"	1335
SS. soft. 8 bailers salt water per hour,	5	"	1340
SS. hard,	20	"	1360
SS. hard. Big vein salt water, 20 bailers per hour,	5	"	1365
SS. hard and soft, (bottom of "Big Injin.") Cased at 1382',	50	"	1415
Slate, black,	20	"	1435
Slate, white,	32	"	1467
Slate, black,	18	"	1485
Limestone,	5	"	1490
"Top of 'Big Sand' or Calciferous Lime rock, called Mountain limestone; 700' from Gas sand and 1000' from 3rd sand or Gordon sand. Hardest drilling in well,"			
White SS. and limestone mixed, hard,	80	"	1570
SS. softer,—1st break in "Big Sand,"	10	"	1580
SS. white and yellow, hard,	90	"	1670
SS. black,	20	"	1690
SS. white, hard,	25	"	1715
SS. yellow,	10	"	1725
SS. muddy—bottom of "Big sand,"	15	"	1740
Slate and very hard shells,	30	"	1770
SS. very hard—called 1st Sand,	30	"	1800

Slate and shells, white,	230	to 2030
SS. dark gray—hardest sand in well,	20	" 2050
Shells and Slate, very hard,	47	" 2097
Slate, nice, good drilling,	40	" 2137
SS. 2nd sand or Gantz sand,	30	" 2167
Slate, (Steel measurement,)	20	" 2187
"SS. white and gray—Called 50 ft. rock. Hard shell on top—then soft and oil; then shell; then soft and Big oil; 75 bbls. per day, about 15′ in rock,"	50	" 2237
Red sand,	15	" 2252
Slate and Shells,	92	" 2344
Red Sand,	25	" 2369
Stray sand, top,	10	" 2379
" " bottom,	25	" 2404
SS. white—Gordon Sand,	16	" 2420
Depth of Well,		2420

Salt Water in bottom of Gordon Sand, which was shut out by inserting a wooden plug and rubber packer.

Parkinson well.

1886.

Belonging to the West Virginia Natural Gas Company, and located on the Parkinson lot, near the southeasterly line of Mount Pleasant township, Washington county, about two miles southeast from Hickory Post Office. Record made from the sand pumpings preserved.

Specimen Nos.			
	Well mouth above ocean in feet.		
	Conductor,	30	to 30
1.	Limestone, gray,	7	" 37
2-3.	Sha'e, slaty,	38	" 75
4.	Limestone, fawn color,	5	" 80
5.	SS. gray and brown, mica, flaky,	5	" 85
6.	Slate, dark,	5	" 90
7-8.	SS. shaly, gray and brown,	10	" 100
9	Limestone, dark, gray, hard, sandy,	5	" 105
10-11.	Limestone, fawn color,	25	" 130
12.	Slate, dark,	15	" 145
13.	SS. shaly, greenish-gray and fawn, mica,	15	" 160
14.	Slate, gritty, black,	25	" 185
15-16.	" black, bituminous,	30	" 215
17.	Limestone, lead color,	10	" 225
18.	" and sand, gray and fawn,	25	" 250
19.	" fawn color,	20	" 270
20.	Lime and slate,	15	" 285
21.	Sandy shale,	30	" 315

22.	SS. very fine, dark, mica,		10	to	325
23.	" friable, slaty, dark and gray mixed, mica,	25	105	"	430
24.	" more solid,	20			
25–26.	" mixed with sandy slate,	40			
27.	" hard, flaky, light-gray,	20			
28.	Slate, dark, and dark limestone,		15	"	445
29–30.	Sandy slate and clay, red; lime,		35	"	480
31.	" shale, gray-green and red; lime,		20	"	500
32.	" " dark, fine grit, pyrites; lime,		15	"	515
33.	Shale, gray, soft, muddy,		25	"	540
34–35.	Slate and sandy shale, some lime,		35	"	575
36–44.	" common,		50	"	625
45–46.	Sandy slate or hard sand shells,		10	"	635
47–48.	Slate, common,		10	"	645
49.	SS. or sandy slate, hard,		5	"	650
50.	Limestone and slate,		5	"	655
51–52.	SS. gray, fine, slaty structure,		10	"	665
53–57.	Slate, common,		25	"	690
58.	" and sand shells,		5	"	695
59–62.	" sandy,		20	"	715
63–65.	SS. friable, massive, white,		15	"	730
66.	Slate and trace of coal,		5	"	735
67–74.	" common,		40	"	775
75–76.	" sandy,		10	"	785
77–81.	" dark,		25	"	810
82.	" and sand shells,		5	"	815
83–84.	" dark,		12	"	827
85–87.	Sand and dark sandy slate,		13	"	840
88.	Sandy slate, black, trace of coal,		5	"	845
89.	Slate,		5	"	850
90–91.	SS. dark brown, fine, rotten, trace of coal and considerable lime,		10	"	860
92.	SS. limestone and slaty shale,		7	"	867
93–108.	Slate, common, very uniform,		78	"	945
109–111.	Dark sandy slate and thin sand shells, gray,		15	"	960
112–113.	SS. white, fine, massive, friable,		10	"	970
114–117.	Slate, common,		20	"	990
118–119.	SS. and little slate,		10	"	1000
120.	" gray and considerable lime,		5	"	1005
121.	Dark slate,		5	"	1010
122–123.	Dark shale and Ferriferous limestone, (?)		10	"	1020
124–132.	Slate, dark,		45	"	1065
133–134.	Sandy slate,		10	"	1075
135–137.	Slate, common, purplish,		15	"	1090
138–143.	" black, bituminous,		30	"	1120
144.	Slate and sand shells, mica, flaky,		5	"	1125
145.	" bituminous, trace coal,		6	"	1131
146–149.	SS. gray, friable, mica and coaly films,		24	"	1155
150–153.	Slate, dark, mica, sandy,		22	"	1177
154–156.	SS. gray, friable, solid at bottom,		16	"	1193
157–159.	Slate, black,		15	"	1208

160.	Slate and shells,	5	to	1213
161.	"	5	"	1218
162–169.	SS. gray, friable, massive,	32	"	1250
170–171.	Slate, very dark,	10	"	1260
172–175.	Dark gray limestone, slaty fracture,	13	"	1273
176–179.	Silicious limestone, light-gray and white,	12	"	1285
180–186.	" " cream white,	17	"	1302
187–189.	SS. gray,	10	"	1312
190.	Slate and clay shale,	4	"	1316
191–192.	SS. slaty, micaceous,	8	"	1324
193.	SS. yellow-gray, fine, solid,	3	"	1327
194.	Slate,	2	"	1329
195–224.	SS. white, medium-grain, massive,	106	"	1435
225.	Slate,	6	"	1441
226–229.	SS. hard, and layers of slate,	16	"	1457
230–231.	SS. white, fine, hard,	11	"	1468
232–236.	Slate, common,	27	"	1495
237.	SS. white, friable, micaceous,	7	"	1502
238–247.	Slate, common,	53	"	1555
248–252.	SS. gray, fine, flaky; trace lime,	25	"	1580
253–270.	Slate, common, (sandy 1610′ to 1620′,)	60	"	1640
271–275.	" and shells,	25	"	1665
276–278,	Sandy slate,	15	"	1680
279–290.	Slate, common,	60	"	1740
291–292.	SS. gray, hard, flaky, trace of lime,	10	"	1750
293–309.	Slate,	85	"	1835
310–313.	SS. hard, fine, flaky, trace of lime,	13	"	1848
314–318.	Slate,	22	"	1870
319.	SS. hard, fine, flaky,	3	"	1873
320–322.	Sandy slate,	7	"	1880
323–328.	Slate, common,	30	"	1910
329.	" and reddish clay,	5	"	1915
330–340.	Slate, common,	58	"	1973
341–343.	SS. white, fine,	12	"	1985
344–345.	" and a little dark slate,	7	"	1992
346.	" white, medium, solid,	2	"	1994
347–348.	" and some slate,	6	"	2000
349–351.	" light-gray, solid, lime,	15	"	2015
352–367.	Slate, common,	79	"	2094
368.	Sandy lime and fossils,	4	"	2098
369–386.	Slate, common,	100	"	2198
387.	SS. pebbles—gas,	7	"	2205

A very large flow of gas was struck in the last sand.

The Survey is indebted to Mr. T. J. Vandergrift for a very complete set of sand pumpings from this well. They were not accompanied by any notes of the drillers, and possibly some of the thicknesses of strata as given above may not agree exactly with the drillers' record. Say a specimen of sand is marked 800 feet, and the next specimen is slate and marked 810 feet. Of course, no one but the driller can tell at what point within that ten feet the sandstone ends and the slate commences. These specimens, however, were taken at such short intervals that there is not much room for mistakes. If we had similar sand pumpings from a well or two in every sub-division of the oil and gas fields, we should soon thoroughly understand the details of the underground structure throughout the whole region.

Well Records in Greene county.

Waynesburg Gas Co. No. 1.

1885.

Located on the north bank of the south fork of Ten Mile Creek at Waynesburg, Franklin township, Greene Co.

Authority—drillers record as given to the owners.

Well mouth above ocean in feet (barometer,)				970
Conductor,	13½	to	13½	956½
Lime, hard,	1½	to	15	955
Slate, black,	30	to	45	925
SS. hard,	50	to	95	875
Slate,	5	to	100	870
Coal,	5	to	105	865
Fire clay,	3	to	108	862
Slate,	5	to	113	857
SS.,	3	to	116	854
Slate,	6	to	122	848
Fire clay,	3	to	125	845
Slate,	10	to	135	835
Lime,	5	to	140	830
Slate,	42	to	182	788
Lime,	18	to	200	770
Slate,	10	to	210	760
Lime,	35	to	245	725
Slate,	10	to	255	715
Lime,	30	to	285	685
Slate,	10	to	295	675
Sand,	18	to	313	657
Slate and coal,	3	to	316	654
Slate,	12	to	328	642
Sand,	38	to	366	604
Lime,	9	to	375	595
Slate,	90	to	465	505
Sand,	20	to	485	485
Slate,	10	to	495	475
Red rock,	85	to	580	390
Shell,	5	to	585	385

Red rock,	5	to 590	380
Sand shells,	40	to 630	340
Red rock,	90	to 720	250
" " (786 ft. casing,)	118	to 838	132
Slate, black,	20	to 858	112
" white, (salt water)	10	to 868	102
" black,	10	to 878	92
SS.,	7	to 885	85
Slate, black, (salt water,)	10	to 895	75
SS.,	40	to 935	+ 35
Slate,	85	to 1020	— 50
SS.,	40	to 1060	— 90
Slate,	70	to 1130	— 160
SS. white,	15	to 1145	— 175
" gas sand,	44	to 1189	— 219
Slate, black,	236	to 1425	— 455
SS. (salt water,)	65	to 1490	— 520
Shelly slate,	35	to 1525	— 555
Red rock,	20	to 1545	— 575
"Shelly shale and slate," (Dark slaty limestone,)	55	to 1600	— 630
White lime,"	10	to 1610	— 640
SS. white, (should be 100' of limestone and 230' SS.,)	330	to 1940	— 970
Slate, black,	40	to 1980	—1010
" shelly,	75	to 2055	—1085
SS. dark,	20	to 2075	—1105
Slate, shelly,	160	to 2235	—1265
SS. gray,	40	to 2275	—1305
Slate, coarse,	31	to 2306	—1336
Slate, shelly,	49	to 2355	—1385
Sand, pebble,	10	to 2365	—1395
Slate, shelly,	25	to 2390	—1420
Pebble,	2	to 2392	—1422
SS. white and hard,	25	to 2417	—1447
" shelly,	20	to 2437	—1467
Slate and shells,	28	to 2465	—1495
" red,	30	to 2495	—1525
SS. red,	75	to 2570	—1600
" white,	8	to 2578	—1608
Slate,	5	to 2583	—1613
SS. red,	9	to 2592	—1622
Slate,	26	to 2618	—1648
SS. red, (gas at 2650',)	67	to 2685	—1715
" red and white,	15	to 2700	—1730
Slate, shelly,	20	to 2720	—1750
SS. pebble,	17	to 2737	—1767
" gray,	8	to 2745	—1775

At 2745 feet while drilling in what was considered a good sand, with quite a considerable show of oil, the cable parted and after a long siege of fishing, the hole was abandoned.

Carpenter well.

Aug. 1885.

On Garrard farm, Green township, Greene Co., Pa. From driller and others.

Well mouth above ocean in feet,			?
Hard drilling, (sheet iron pipe 200',)		255	to 255
Coal,		5±	to 260
Shales and bastard SS.,		315	to 575
Red rock,		23	to 598
Slate and shells, (Cased ot 602' or 610',)		103	to 701
SS. poor,	15	30	to 731
Slate,	7		
SS. good,	8		

No water with oil and not enough gas to make the well flow without agitation.

Old Glass House well, Greenesboro', Greene Co.

1865.

Authority "Phin." Thompson.

Well mouth above ocean in feet,	?
Drive pipe,	30 to 30
? (Cased 220' to 250'. Seed bag on tubing 300',)	278 to 308
SS. (Oil show and gas at 320',) 8' to 10' slate in center,	35 to 343
?	265 to 608
SS. white, fine not very hard, ferruginous. No oil, no gas, no water,	60 to 668

"Tubed in upper sand but could not exhaust the mineral water with 2½ inch tubing. Tested 4 or 5 weeks and got a little oil like lard. It floated on the water like nuts. The well flowed occasionally and then threw out green oil of a lighter gravity."

Well Record in Allegany county, N. Y.

Triangle well No. 1.

June, 1879.

Located on the Crandall farm, lot No. 4, Scio township, Allegheny county, N. Y., about 4¾ miles southwest from Wellsville. Authority, O. P. Taylor. A complete set of sand pumpings preserved by Mr. Bellamy.

Well mouth above ocean in feet, (barometer.)				1,875
Sandy shale, bluish and brown,	130	to	130	1,745
do. streaked with pale red,	40	"	170	1,705
Red shale—soft,	15	"	185	1,690
?	15	"	200	1,675
Red sand, very fine grained,	1	"	201	1,674
SS. gray, and some brown,	10	"	211	1,664
Sandy shale and sand shells (water,)	29	"	240	1,635
SS. brown, fine grained,	6	"	246	1,629
Slate and shells, iron pyrites,	54	"	300	1,575
SS. gray, hard, fine grained,	15	"	315	1,560
Slaty shale, bluish, pyrites, fossils,	150	"	465	1,410
SS. gray, flaggy, hard,	35	"	500	1,375
SS. white, massive, friable, "1st SS.,"	22	"	522	1,353
Slaty shale, dark, gritty,	33	"	555	1,320
SS. white, in layers,	4½	"	559½	1,315½
SS. dark, red, oolitic structure, fossils,	½	"	560	1,315
Slate, common,	52	"	612	1,263
SS. white, fine, fossils and lime,	4	"	616	1,259
Shale, gritty, bluish,	21	"	637	1,238
SS. hard, light gray,	1	"	638	1,237
Slate, gritty, mica,	47	"	685	1,190
SS. medium, light gray, fossils in top "2nd SS.,"	37	"	722	1,153
Slate, dark and shaly,	135	"	857	1,018
SS. grayish-white, fossils,	9	"	866	1,009
Slaty shale, bluish,	119	"	985	890
SS. dove color, very fine, (oil show,)	20	"	1,005	870
Slate, common,	104	"	1,109	766
SS. chocolate brown, fine, (oil,)	44	"	1,153	722
SS. almost black,	24	"	1,177	698

A moderate producer. This was one of the pioneer wells.

Well Record in Potter county.

Guffey well.

1886.

Located on W. B. Gordnier farm, Mill Brook, at the east edge of the borough of Coudersport, Eulalia township, Potter county.

Specimen Nos.					
	Well mouth above ocean in feet, (barometer,)				1,700
	?	170	to	170	1,530
	SS. and shale, chocolate color,	100	"	270	1,430
	SS. dark, (cased off fresh water, 310,)	40	"	310	1,390
1.	Slate and micaceous shells,	180	"	490	1,210
2.	do.	20	"	510	1,190
3.	Micaceous sand layers and slate,	40	"	550	1,150
4.	do.	10	"	560	1,140

5.	Slate and sand, dark,	100	to	660	1,040
6.	Slate, common,	140	"	800	900
7-11.	SS. brownish, laminated, mica, fine grit, oil smell,	35	"	835	865
12-13.	Sandy slate, brownish sand,	85	"	920	780
14-15.	Slate, common,	70	"	990	710
16-17.	SS. greenish gray, fine, mica, little slate,	25	"	1,015	685
18.	SS. " " and brown,	5	"	1,020	680
19.	Slate, dark, common,	55	"	1,075	625
20-26.	SS. and sandy slate in layers, mica,	75	"	1,150	550
27-29.	Sandy slate,	30	"	1,180	520
30-31.	Slate, fine grit and mica,	110	"	1,290	410
32-34.	SS. gray-brown, flaky, mica, fine,	18	"	1,308	392
35-37.	Slate,	30	"	1,338	362
38.	SS. gray-brown and slate, little gas at 1350,)	30	"	1,368	332
39.	Slate,	25	"	1,393	307
40.	SS. dark, fine, with slate,	7	"	1,400	300
41-49.	Slate, common,	252	"	1,652	+48
50-65.	Slaty sandstone, very fine grit and much mica; brown and dark gray, "3rd SS.," (little gas,)	100	"	1,752	— 52
66-74.	Slate, sandy, mica, brown and dark gray,	40	"	1,792	— 92
75-76	SS. dark, fine, with slate,	8	"	1,800	—100
77-82.	Slate,	20	"	1,820	—120
83.	" and fine sand,	5	"	1,825	—125
84.	Slate,	5	"	1,830	—130
85.	" and shells, gray,	10	"	1,840	—140
86-87.	Slate,	10	"	1,850	—150
88.	Sandy slate,	10	"	1,860	—160
89-92.	Slate,	180	"	2,040	—340
93.	SS. brown-gray, fine, and slate, "4th SS.,"	20	"	2,060	—360
	Slate to bottom,	40	"	2,100	—400

A small flow of gas, but of no commercial value.

Well Record in Indiana county.

Boice well.

1883.

On the Snyder farm, west side of Canoe creek, half a mile north east from Covode, Canoe township, Indiana Co. Authority, John Boice.

Well mouth above ocean in feet, said to be,				1,540
?	40	to	40	1,500
Coal,	4	to	44	1,496
?	356	to	400	1,140
Cannel coal, (?)	40	to	440	1,100

SS.,		360 to 800	740
Slate and shells, (cased at 815′,)		290 to 1,090	450
SS. white and pebbly, "1st sand,"		225 to 1,315	+ 225
Slate,		235 to 1,550	— 10
Red rock, soft, (first red,)		140 to 1,690	— 150
Slate with three streaks of red,		110 to 1,800	— 260
SS. brownish gray, (no gas or oil,) "2d sand,"		18 to 1,818	— 278
Slate and shells, good drilling,		642 to 2,460	— 920
SS. "Stray," (show of oil and gas,)		30 to 2,490	— 950
Slate, soft,		125 to 2,615	—1,075
SS. black, fine, hard, solid, "3d sand," (strong gas,)	65	125 to 2,740	—1,200
Slate,	4		
SS. brownish, friable, (no oil or gas,)	56		
Slate,		5 to 2,745	—1,205

The principal flow of gas was found about 65 ft. from top of sand. It is now piped to Punxsutawney and supplies the town.

Well Record in Jefferson county.

Brookville Well No. 2.

Fall of 1884.

Located in the borough of Brookville, Rose township, Jefferson county. Authority, S. A. Craig.

Well mouth above ocean in feet.		
Conductor,	18 to	18
SS. "Mountain sand,"	90 to	108
Slate,	20 to	128
SS. "Mountain sand,"	46 to	174
Slate,	4 to	178
SS. gray, hard,	22 to	200
Red rock,	5 to	205
Slate and shells,	20 to	225
SS. gray,	45 to	270
Red rock,	5 to	275
Slate, soft,	7 to	282
Red rock,	11 to	293
Sand and layers of slate,	25 to	318
Red rock,	12 to	330
Slate and shells,	32 to	362
SS, ("40′ rock or salt water sand,") strong salt water,	38 to	400
Slate and shells, (salt water,)	86 to	486
SS. "1st sand,"	25 to	511
Slate and shells, (cased 551,)	104 to	615
SS. pebbly—gas and salt water,	12 to	627
Slate and shells,	70 to	697
SS. gray, (little gas,)	30 to	727
Slate and shells, (casing lowered to 730,)	110 to	837

SS. gray, hard,		10 to	847
Red rock,		50 to	897
Slate and shells,		10 to	907
SS.,		12 to	919
Red rock,		148 to	1,067
Slate, white,		10 to	1,077
SS. gray,		8 to	1,085
Red rock,		17 to	1,102
Slate and shells,		40 to	1,142
Red rock,	10	16 to	1,158
" " hard shell,	6		
Slate and shells,		336 to	1,494
Black rock,		15 to	1,509
Slate and shells,		140 to	1,649
" soft,		108 to	1,757
Slate and red rock,		6 to	1,763
" soft,		90 to	1,853
Sandy shells,		15 to	1,868
Slate, soft,		50 to	1,918
SS., (gas rock,) little gas,		27 to	1,945
Slate,		6 to	1,951

"Well No. 1 (600 ft. south,) corresponds with this except that the last sand was 35′ thick and the gas 10 times stronger. It was drilled to 2,430 in slate and shells. No deeper gas sands or gas."

Well Record in Fayette county.

Bellevernon Gas well No. 1.

1884.

Near the Glass works at Bellevernon, Washington township, Fayette county. Authority, J. S. Wall, of Monongahela City.

Well mouth above ocean in feet about,					780
Clay,	19	to	19		761
Soapstone,	35	"	54		726
Red shale,	210	"	264		516
Slate,	105	"	369		411
SS.,	20	"	389		391
Shale, soft,	68	"	457		323
" black,	35	"	492		288
SS.,	15	"	507		273
Limestone,	34	"	541		239
Slate,	60	"	601		179
SS.,	50	"	651		129
Slate,	40	"	691		89
SS.,	35	"	726		54
Soapstone,	6	"	732	+	48

SS.,	105	to	837	— 57
Slate,	15	"	852	— 72
Mountain sand,	100	"	952	— 172
Shale,	30	"	982	— 202
Slate, gray,	57	"	1,039	— 259
SS.,	10	"	1,049	— 269
Red shale,	23	"	1,072	— 292
Slate,	12	"	1,084	— 304
Red slate,	11	"	1,095	— 315
SS. gray,	15	"	1,110	— 330
Slate, white,	55	"	1,165	— 385
SS.,	258	"	1,423	— 643
Slate and sand,	40	"	1,463	— 683
Slate, gritty,	42	"	1,505	— 725
SS..	18	"	1,523	— 743
Slate, blue,	20	"	1,543	— 763
SS., gray,	66	"	1,609	— 829
SS. & slate,	38	"	1,647	— 867
SS.,	13	"	1,660	— 880
Slate, blue,	27	"	1,687	— 907
SS. & slate,	37	"	1,724	— 944
SS.,	10	"	1,734	— 954
Shale, hard,	45	"	1,779	— 999
Red shale,	10	"	1,789	—1,009
SS.,	75	"	1,864	—1,084
Shale,	13	"	1,877	—1,097
Red slate,	14	"	1,891	—1,111
SS.—gas, a moderate flow,	14	"	1,905	—1,125
SS.,	62	"	1,967	—1,187
SS.—(crevice,)	12	"	1,979	—1,199
SS. and slate,	26	"	2,005	—1,225

A small gas well.

Well Records in Beaver county.

Vandergrift well.

April, 1885.

Located on Service creek, Independence township, Beaver county. Authority T. J. Vandergrift.

Well mouth above ocean in feet.

Soil and sandy shale,	41	to	41
SS. shaly, greenish,	6	to	47
" and shale,	40	to	87
Coal—say 1′,	1	to	88
?	2	to	90
Coal—say 1′,	1	to	91
Shale, sandy,	39	to	130
Coal, trace,			130
Shale, sandy,	40	to	170

Shale,		10 to 180
SS. dark and light, shaly,		20 to 200
Shale.		15 to 215
Coal slate,		2 to 217
?		113 to 330
Shale, dark,		10 to 340
?		50 to 390
Sandy shale, dark,		20 to 410
SS. white, medium, friable, trace coal,		110 to 520
Slate or shale, (cased at 526',)		15 to 535
SS. white, friable, ("buttermilk rock,")		73 to 608
Coal, (dark slaty seam in SS.,) say,		2 to 610
SS. yellow, white, friable,		135 to 745
?	85	250 to 995
SS. light gray, fine, mica, flaky,	15	
?	150	
SS. and limestone—fossils,		45 to 1040
?		120 to 1160
SS. gray, very fine and compact, lime,		63 to 1223
SS. do		
SS. do, more lime		
Slate, purplish, fossils,		? to ?

Unproductive.

Darlington well.

1886.

Located near Darlington, Beaver county. Authority, Gillespie & Armstrong.

Well mouth above ocean in feet.	
Gravel. (Drive pipe 60',)	54 to 54
Bed rock,	36 to 90
Slate,	60 to 150
Coal,	4 to 154
Slate,	30 to 184
SS.,	40 to 224
Slate and black sand,	45 to 269
SS. hard,	20 to 289
Slate,	5 to 294
Mica and iron ore,	15 to 309
Salt water sand,	20 to 329
Slate and sand,	88 to 417
Salt water sand,	35 to 452
Sand and slate,	43 to 495
Salt water sand,	30 to 525
Slate and shale, (oil at 650',)	145 to 670
Salt water sand, (cased at 778',)	110 to 780
Slate,	100 to 880
SS. (1st gas at 880',)	20 to 900
Oil sand,	15 to 915

Slate and shale,	85 to 1000
" " (2d gas at 1080',)	80 to 1080
Slate, (3d gas at 1145',)	65 to 1145
Slate and shale,	170 to 1315
Shale, (4th gas at 1360', ice formed in well,)	1125 to 2440

Unproductive.

Well Records in West Virginia.

St. James well.

Dec. 1884.

About 3 miles E. N. E. of Wheeling, and near Triadelphia, Ohio Co., West Va. From the drillers record kept for J. K. Lanahan the owner.

Well mouth above ocean in feet,		?
Conductor, gravel and sand,	20 to	20
Slate,	8 to	28
Limestone,	18 to	46
Slate and fine clay,	9 to	55
Coal and coal slate,	5 to	60
Slate and shale,	15 to	75
Limestone,	5 to	80
Shale and fire clay,	35 to	115
SS.,	6 to	121
Slate and fire clay,	10 to	131
Red clay,	8 to	139
Fine clay,	11 to	150
Red clay,	5 to	155
Fine clay and slate,	15 to	170
Shale,	5 to	175
Fire clay—red and white, inclined to cave,	30 to	205
Slate and shale,	55 to	260
Slate,	42 to	302
SS.,	6 to	308
Clay and slate,	42 to	350
Shale, dark,	12 to	362
Clay and slate, (cased at 396',)	34 to	396
Slate,	22 to	418
SS. gray, (a little gas,)	12 to	430
Slate, black,	25 to	455
Slate, gray, or soapstone,	15 to	470
" mixed with sandy shale,	65 to	535
SS. white, very soft, (a little more gas,)	30 to	565
Slate and sand shells, gray,	60 to	625
Sandy shale,	15 to	640
Slate, black,	12 to	652
SS. hard,	6 to	658
Slate, black,	45 to	703
Sandy shale,	10 to	713

Slate or soapstone, light colored,	30 to 743
SS. white, changing to dark, not very hard,	103 to 846
Shale, black,	10 to 856
Slate,	10 to 866
Hard rock, changing to softer, white. Much salt water at 875',	70 to 936
Slate. (Put in 940' casing; cased in slate,)	35 to 971
White rock, soft,	30 to 1001
" " growing harder. (Put in 1060' casing,)	59 to 1060
" " hard changing to softer, (little oil and gas at 1210',)	310 to 1370
Slate and occasional shells,	120 to 1490
SS. soft,	10 to 1500
Slate and shale,	197 to 1697
Dark rock, hard,	5 to 1702
? no sand,	118 to 1820
SS. grayish, a shell,	4 to 1824
? (No sand, soft drilling,)	56 to 1880
Red shale or clay, very red,	6 to 1886
? (No sand, soft drilling,)	114 to 2000

No oil, no gas, and work discontinued at 2000 feet.

E. M. Hukill & Co. No. 1.

Oct., 1886.

On the Gallahue farm, Davis Run, 2 miles east of Farmington station, Marion Co., West Virginia. Authority E. M. Hukill.

Well mouth above ocean in feet,	?
Conductor, clay,	12 to 12
Limestone,	108 to 120
Coal,	8 to 128
Limestone,	100 to 228
Coal,	12 to 240
Sand,	330 to 570
Coal,	6 to 576
Red rock,	60 to 636
Slate and shell, (864' of 7⅝ casing,)	218 to 854
Black sand,	70 to 924
Slate and shell,	266 to 1190
Sand, (water at 1210',)	100 to 1290
Shell,	10 to 1300
Slate, (5⅝ casing.)	17 to 1317
Black slate,	70 to 1387
Sand,	12 to 1399
Red rock,	80 to 1479
Limestone,	100 to 1579
Sand,	92 to 1671
Slate and shell,	70 to 1741

Limestone,	5	to	1746
White sand,	60	to	1806
Slate and shell,	120	to	1926
Black slate,	25	to	1951
Slate and shell,	105	to	2056
Sand,	35	to	2091
Slate,	20	to	2111
Slate and sand shells,	35	to	2146
Slate and shell,	65	to	2211
Red rock,	110	to	2321
Slate and shell,	20	to	2341
Sand,	7	to	2348
Red rock,	184	to	2532
Slate,	50	to	2582
Pebble SS., (very large flow of gas,)	5	to	2587
Gray SS.,	24	to	2611
Slate to bottom,	200	to	2811

Abandoned.

Barclay well.

Wellsburg, West Va. Well mouth 30′ to 40′ above low water in Ohio river. High water has been on derrick floor.

Well mouth above ocean in feet,			?
Yellow clay, . . 20			
Blue, " . . 20 } 72 drive pipe, (gas at 43,)	72	to	72
Gravel, ... 32			
SS. blue,	6	to	78
Slate, black, (gas at 100′.)	35	to	113
Fire clay,	22	to	135
SS. white,	12	to	147
Fire clay,	40	to	187
Slate,	12	to	199
Coal, shaft coal,	5	to	204
Fire clay, (cased 208,)	10	to	214
Slate, (cased 225,)	20	to	234
Slate and shale,	40	to	274
SS. white, (gas at 287,)	40	to	314
Slate and shale, (cased 300,)	74	to	388
SS. (gas 400,)	15	to	403
Slate and shale, (cased 410,)	75	to	478
SS. white, salt water, (gas 535,)	75	to	553
SS. gray,	30	to	583
" blue,	40	to	623
Coal,	6	to	629
Slate and shale,	31	to	660
SS. white, (gas and salt water 750,) (cased 777,)	140	to	800
Slate and shale, (salt water 850,)	50	to	850
SS. white, (gas 857,)	50	to	900
Erie shale,	400	to	1300
SS. white,	10	to	1310

"At 1310 struck big flow of gas so strong as to prevent further drilling."

Well Records in Ohio.

Jefferson Iron Works well.

Steubenville, half a mile below the Cleveland and Pittsburg R. R. station. Authority, the Company's record book.

Well mouth above ocean in feet,				665'
Sand, gravel and limestone,	78'	to	78'	587'
Bastard limestone,	20'	to	98'	567'
Blue clay,	12'	to	110'	555'
Sand, blue,	5'	to	115'	550'
Fire clay,	32'	to	147'	518'
Sand, grey,	13'	to	160'	505'
Coal,	3'	to	163'	502
Fire clay,	32'	to	195'	470'
Sand, blue,	7'	to	202'	463'
Coal,	4'	to	206'	459'
Fire clay,	60'	to	266'	399'
Shell rock,	23'	to	289'	376'
Sand, white,	85'	to	374'	291'
Slate, black,	20	to	394'	271'
Shell rock,	25'	to	419'	246'
Black slate and shells,	125'	to	544'	121'
Limestone, green,	5'	to	549'	116'
" white,	45'	to	594'	71'
Slate, black,	3'	to	597'	+ 68'
Sand, white,	82'	to	679'	— 14'
Sand, shell,	10'	to	689'	— 24'
Slate, black,	30'	to	719'	— 54'
Sand, white,	140'	to	859'	— 194'
Slate, black,	280'	to	1139'	— 474'
Limestone,	10'	to	1149'	— 484'
Erie shales,	75'	to	1224'	— 559'
Gas rock,	5'	to	1229'	— 564'
Slate, black,	1290'	to	2519'	—1854'

East Liverpool Gas Co's. well No. 2.

May, 1885.

On Little Beaver Creek, about a mile above Island Run, Columbiana Co. Ohio. Record as given by the contractor, Mr. Hammel.

Well mouth above ocean in feet, (barometer,)				740
Conductor,	10	to	10	730
Hard sand,	25	"	35	705
Slate and shells,	100	"	135	605

Gray sand, (mud vein,)	40	"	175	565
Shale,	35	"	210	530
White sand, ("glass rock,")	40	"	250	490
Slate and shells, (cased 250',)	100	"	350	390
1st Blue rock, (sandstone,)	35	"	385	355
Slate and shells,	50	"	435	305
Stray sand, white, fine, (little gas,)	10	"	445	295
Slate and shells, black,	40	"	485	255
2d Blue rock,	40	"	525	215
Black sand, (like coffee grounds,)	10	"	535	205
Slate and shells,	15	"	550	190
Black slate,	25	"	575	165
Gas sand,	25	"	600	140

Mr. Hammel says the New Lisbon well showed a similar record. It struck the oil or gas sand at 610′ and passed through it at 628′. From 628′ to the bottom (1350′) he gives the following figures from memory, but very positively:

Bottom of oil or gas rock,			628
Slate,	10	to	638
Salt water sand, soft,	20	"	658
Slate,	70	"	728
Red rock,	90	"	818
Slate—no sands,	532	"	1350

Mr. Hummel asserts that he found the red rock in a similar position in every well he has drilled below the Smiths' Ferry oil sand.

Salem Gas well.

1886.

Near the R. R. Station at Salem, Columbiana Co., Ohio. Authority, T. C. Purdy.

Well mouth above ocean in feet, about,				1290′
Conductor, &c.,	113	to	113	1177
Coal,	2	"	115	1175
Slate,	85	"	200	1090
SS.,	25	"	225	1065
Slate, reddish,	15	"	240	1050
SS,	12	"	252	1038
Slate,	12	"	264	1026
SS.,	53	"	317	973
Coal,	5	"	322	968
Slate,	10	"	332	958
SS. gray,	20	"	352	938
Slate,	70	"	422	868
SS. white,	28	"	450	840

Slate, black,	102	"	552	738
" light,	298	"	850	440
SS. "Berea grit,"	90	"	940	+ 350
Slate,	360	"	1300	— 10
Pebble, "2d sand,"	10	"	1310	— 20
Slate,	1620	"	2930	—1640

"After leaving the second sand it was slate all the way down. No third sand found. Struck a lime rock at 2930 feet." The well is unproductive.

North Baltimore well.

March, 1886.

Located in section No. 34, Henry township, Wood Co., Ohio. Authority, T. J. Vandergrift.

Well mouth above ocean in feet.

Drive pipe,	43	to	43
Water lime,	107	"	150
Niagara lime,	140	"	290
" shale, (cased at 303½',)	13	"	303
Clinton limestone,	89	"	392
Medina shale, blue,	47	"	439
" " red,	45	"	484
Hudson river shale,	416	"	900
Utica shale,	290	"	1190
Trenton limestone,	105	"	1295

"Oil in Trenton limestone at 17½ feet and again at 28 ft.; none below. Salt water at the bottom of the well."

Vandergrift well No. 1.

Aug. 1886.

On Franks farm, section No. 35, Henry township, Wood Co., Ohio. Authority, T. J. Vandergrift.

Well mouth above ocean in feet.

Conductor,	33	to	33
Water lime, brown,	67	"	100
Niagara limestone, white,	180	"	280
" shale,	13	"	293
Clinton limestone,	64	"	357
Medina shale, blue,	70	"	427
" " red,	35	"	462
Hudson river shale,	402	"	864
Utica shale,	306	"	1170
Trenton limestone,	42	"	1212

The Chemical Composition of Natural Gas.

BY FRANCIS C. PHILLIPS,

Professor of Chemistry, Western University, Allegheny, Penn'a.

Introduction.

Natural gas, as obtained from several of the most productive fields in Pennsylvania, according to the analytical data presented in this report, consists chiefly of the hydrocarbons of the paraffin series, together with nitrogen, a small proportion of carbon dioxide and traces of oxygen. Free hydrogen was found in minute quantity in Speechley gas. It is possible that by employing many thousand cubic feet of gas, traces of other constituents might be discovered. Inasmuch as the composition of natural gas possesses an interest for those who are not familiar with the strictly chemical aspect of the question, a few preliminary statements as to the more characteristic properties of its chief constituents will no doubt prove of value in this connection.

Hydrogen is obtained as a gas by the action of dilute sulphuric acid upon zinc. It is also produced during the putrefaction of vegetable matters buried under stagnant water. Its specific gravity is 0.069234 as compared with

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NOTE.—Prof. Phillips has spent considerable time in the study and practical investigations of gaseous fuels, and at my request he was commissioned in the early part of the year to make analyses of the natural gas from eight of the most prominent pools in the State, and one analysis of the Fredonia gas in New York.

The first systematic investigation as to the composition of natural gas in the State, was made by the Geological Survey in 1875, the results of which were published in a Report on the Use of Natural Gas in Iron Manufacture, in 1876. Since 1883, when the use of natural gas for fuel became more general, numerous analyses of the different gases have been made by a number of chemists. The wide differences in the composition of the gases as shown by these analyses were so great that Prof. Phillips exercised more than special care in the collection of his samples and in the method of determining the individual constituents of the gases. All analyses were made in duplicate.

C. A. ASHBURNER,
Geologist in Charge.

air. One cubic meter weighs 0.089523 kilogram. One cubic foot weighs 39.12 grains. Hydrogen is odorless and tasteless. It takes fire at a bright red heat, and more readily than other constituents of fuel gases.

Hydrogen in burning generates 34180 heat units per unit weight burned. The product of its combustion is water.

In fuel gases hydrogen may occur in two very different forms.

In its *free* or *uncombined* state, it is often reported in the analyses of natural gas, and constitutes generally from 30 per cent. to 40 per cent. by volume of ordinary coal gas, being a product of the destructive distillation of coal at very high temperatures. The presence of a large proportion of *free* hydrogen in a gas fuel causes it to burn with a relatively small admixture of air, since one volume of hydrogen requires only one-half volume of oxygen, or two and one-half volumes of air for complete combustion. The hydrogen flame is non-luminous.

In *combination with carbon*, in the form of hydro-carbons, hydrogen constitutes about one-fourth by weight of the combustible portion of the natural gas now being used as fuel in Pennsylvania.

These hydro-carbons, which represent approximately nine-tenths by volume of natural gas, are divided into two classes: Paraffins and Olefines. Of the paraffins, the best known and most abundant is methane ($C\ H_4$) consisting of 25.03 per cent. hydrogen, and 74.97 per cent. carbon by weight.

Methane is, like hydrogen, a product of the destructive distillation of coal, and consequently constitutes a large proportion of ordinary coal gas. It is also produced with hydrogen when plants decay at the bottom of rivers and swamps, and hence its older name of marsh gas. Methane, when pure is odorless, and not poisonous. Its specific gravity is 0.55297. One cubic meter weighs 0.7148 kilogram. One cubic foot weighs 312.36 grains. It is converted into a liquid under a pressure of about 2700 lbs. per square inch at 12° F., or at 263° below zero F., under atmospheric pressure. Methane requires twice its volume of oxygen or ten

volumes of air for its complete combustion, and the products are carbon dioxide and water vapor.

The Hukill well, Lyon's run, south of Murrysville, as already stated, yields this gas in a nearly pure condition. Methane contains *in one cubic foot, two cubic feet of hydrogen*, and hence in the union of the carbon and hydrogen, a considerable condensation occurs. Methane is the typical and best known member of a large group of hydro carbons, which exhibit a remarkable resemblance in chemical relationships. The following list includes several of the most important:

Methane,	$C H_4$
Ethane,	$C_2 H_6$
Propane,	$C_3 H_8$
Butane,	$C_4 H_{10}$
Pentane,	$C_5 H_{12}$
Hexane,	$C_6 H_{14}$
Heptane,	$C_7 H_{16}$
Octane,	$C_8 H_{18}$
	. . . .
	. . . .
	$C_n H_{2n+2}$

The first four hydro-carbons are gases, but are more and more easily condensable to the liquid form in proportion as the amount of carbon is greater. The higher paraffins are solid. Common "paraffin wax" contains several of the highest members. While Methane ($C H_4$) constitutes from 50 per cent. to 90 per cent. or more of Pennsylvania natural gas, Ethane, ($C_2 H_6$), the next member of the series occurs in smaller quantity. Concerning the higher members, Propane, ($C_3 H_8$), and Butane, ($C_4 H_{10}$), very little is as yet known, but there is reason to think that they are of common occurrence. Pentane, ($C_5 H_{12}$), is found in the lightest distillates from petroleum, and the higher members are found in abundance in crude oil. It may be said concerning the gaseous hydro-carbons of the series that they possess higher specific gravity, fuel value and illuminating power, and also stronger odor in proportion as the percentage weight of carbon is greater.

The illuminating power of pure methane, artificially prepared, has been determined as 5.15 to 5.20 standard candles

air. One cubic meter weighs 0.089523 kilogram. One cubic foot weighs 39.12 grains. Hydrogen is odorless and tasteless. It takes fire at a bright red heat, and more readily than other constituents of fuel gases.

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In *combination with carbon*, in the form of hydro-carbons, hydrogen constitutes about one-fourth by weight of the combustible portion of the natural gas now being used as fuel in Pennsylvania.

These hydro-carbons, which represent approximately nine-tenths by volume of natural gas, are divided into two classes: Paraffins and Olefines. Of the paraffins, the best known and most abundant is methane ($C H_4$) consisting of 25.03 per cent. hydrogen, and 74.97 per cent. carbon by weight.

Methane is, like hydrogen, a product of the destructive distillation of coal, and consequently constitutes a large proportion of ordinary coal gas. It is also produced with hydrogen when plants decay at the bottom of rivers and swamps, and hence its older name of marsh gas. Methane, when pure is odorless, and not poisonous. Its specific gravity is 0.55297. One cubic meter weighs 0.7148 kilogram. One cubic foot weighs 312.36 grains. It is converted into a liquid under a pressure of about 2700 lbs. per square inch at 12° F., or at 263° below zero F., under atmospheric pressure. Methane requires twice its volume of oxygen or ten

volumes of air for its complete combustion, and the products are carbon dioxide and water vapor.

The Hukill well, Lyon's run, south of Murrysville, as already stated, yields this gas in a nearly pure condition. Methane contains *in one cubic foot, two cubic feet of hydrogen*, and hence in the union of the carbon and hydrogen, a considerable condensation occurs. Methane is the typical and best known member of a large group of hydro carbons, which exhibit a remarkable resemblance in chemical relationships. The following list includes several of the most important:

Methane,	CH_4
Ethane,	C_2H_6
Propane,	C_3H_8
Butane,	C_4H_{10}
Pentane,	C_5H_{12}
Hexane,	C_6H_{14}
Heptane,	C_7H_{16}
Octane,	C_8H_{18}
	. . . .
	. . . .
	C_nH_{2n+2}

The first four hydro-carbons are gases, but are more and more easily condensable to the liquid form in proportion as the amount of carbon is greater. The higher paraffins are solid. Common "paraffin wax" contains several of the highest members. While Methane (CH_4) constitutes from 50 per cent. to 90 per cent. or more of Pennsylvania natural gas, Ethane, (C_2H_6), the next member of the series occurs in smaller quantity. Concerning the higher members, Propane, (C_3H_8), and Butane, (C_4H_{10}), very little is as yet known, but there is reason to think that they are of common occurrence. Pentane, (C_5H_{12}), is found in the lightest distillates from petroleum, and the higher members are found in abundance in crude oil. It may be said concerning the gaseous hydro-carbons of the series that they possess higher specific gravity, fuel value and illuminating power, and also stronger odor in proportion as the percentage weight of carbon is greater.

The illuminating power of pure methane, artificially prepared, has been determined as 5.15 to 5.20 standard candles

air. One cubic meter weighs 0.089523 kilogram. One cubic foot weighs 39.12 grains. Hydrogen is odorless and tasteless. It takes fire at a bright red heat, and more readily than other constituents of fuel gases.

Hydrogen in burning generates 34180 heat units per unit weight burned. The product of its combustion is water.

In fuel gases hydrogen may occur in two very different forms.

In its *free* or *uncombined* state, it is often reported in the analyses of natural gas, and constitutes generally from 30 per cent. to 40 per cent. by volume of ordinary coal gas, being a product of the destructive distillation of coal at very high temperatures. The presence of a large proportion of *free* hydrogen in a gas fuel causes it to burn with a relatively small admixture of air, since one volume of hydrogen requires only one-half volume of oxygen, or two and one-half volumes of air for complete combustion. The hydrogen flame is non-luminous.

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Ethane,	$C_2 H_6$
Propane,	$C_3 H_8$
Butane,	$C_4 H_{10}$
Pentane,	$C_5 H_{12}$
Hexane,	$C_6 H_{14}$
Heptane,	$C_7 H_{16}$
Octane,	$C_8 H_{18}$
	. . . .
	. . . .
	$C_n H_{2n+2}$

The first four hydro-carbons are gases, but are more and more easily condensable to the liquid form in proportion as the amount of carbon is greater. The higher paraffins are solid. Common "paraffin wax" contains several of the highest members. While Methane ($C H_4$) constitutes from 50 per cent. to 90 per cent. or more of Pennsylvania natural gas, Ethane, ($C_2 H_6$), the next member of the series occurs in smaller quantity. Concerning the higher members, Propane, ($C_3 H_8$), and Butane, ($C_4 H_{10}$), very little is as yet known, but there is reason to think that they are of common occurrence. Pentane, ($C_5 H_{12}$), is found in the lightest distillates from petroleum, and the higher members are found in abundance in crude oil. It may be said concerning the gaseous hydro-carbons of the series that they possess higher specific gravity, fuel value and illuminating power, and also stronger odor in proportion as the percentage weight of carbon is greater.

The illuminating power of pure methane, artificially prepared, has been determined as 5.15 to 5.20 standard candles

In the above described method are determined the weights of carbon and hydrogen per unit volume of gas. In conducting the combustion great care was taken to secure complete oxidation of the combustible constituents, and absorption of the products.

For the absorption of the water sulphuric acid of 1.71 Sp. Gr., followed by phosphoric anhydride, was used, and for the carbon dioxide a solution of caustic potash in glycerine.

For the determination of nitrogen the following method was employed: A porcelain combustion tube containing oxide of copper was brought to a yellow heat, and a stream of carbon dioxide conducted through the tube until the last traces of air were expelled.

The expulsion of the air was considered complete when it was found that the carbon dioxide escaping from the tube was wholly absorbed by a solution of caustic potash.—100 cubic centimeters of such gas not leaving a visible quantity unabsorbed by the alkaline solution. Then, after expulsion of the last traces of air, a quantity of natural gas (100 c. c. were generally employed), was allowed to flow slowly into the stream of carbon dioxide as it entered the combustion tube. In this manner the gas was burned and a mixture of nitrogen and carbon dioxide collected in a eudiometer over caustic potash solution. After the absorption of the carbon dioxide the volume of the residual nitrogen was measured. This nitrogen was carefully tested for carbon dioxide, oxygen and carbon monoxide, and was frequently repassed through the heated combustion tube a second time and again measured, in order to insure the complete combustion of all hydrocarbons. This repetition demonstrated in all but one or two instances that the nitrogen was pure. It was found that with a sufficiently slow stream of gas the oxidation by the oxide of copper is easily rendered complete, although the rate of flow must be regulated with great care.

By the common eudiometric methods of analysis no determination is more difficult than that of nitrogen when occuring in small quantities in admixture with hydrocarbons of the paraffin series. In the method above described large quantities of gas can be employed, and the results are accurate.

The determination of free oxygen in natural gas cannot well be made with the quantity of gas commonly at disposal. A test was made in every instance in about 100 cubic centimeters of gas, using an Elliott apparatus, and as an absorbent a solution of caustic soda and pyrogallic acid. In all cases the results were negative.

I have found it necessary to conduct the tests for oxygen at the wells, and this was done in the following manner:

A slow stream of gas was caused to flow (directly from the well or main) successively through solutions of caustic potash and pyrogallic acid, for 10 minutes, in order to expel dissolved air. Then by a simple contrivance the two fluids were mixed without interrupting the current of gas, which continued some time longer through the mixture. If the mixed fluids then exhibited a brown color, gradually increasing in depth, it was considered that the presence of oxygen was established.

The direct determination of free hydrogen has generally been considered a matter of such difficulty, that in many published analyses its quantity has been estimated by a calculation based upon the total carbon and hydrogen contained in the gas. For the present purpose a direct determination seemed very desirable and the process of Hempel has been used in the manner described below. 100 cubic centimeters of gas, after the removal of carbon dioxide, were washed with strong alcohol until the higher hydrocarbons, ethane, propane, &c. were removed. This was carried out in an Elliott apparatus, having a water jacket. Then the residual gas mixed with two or three times its volume of air was passed over asbestos coated with 30% of Palladium sponge at a temperature of °C.

By this treatment the hydrogen alone is burned, provided the higher paraffins, including ethane are previously removed by washing with alcohol. From the contraction in volume after passing the palladium, the proportion of free hydrogen is easily determined.

The method is very accurate when methane is the only hydro-carbon present. It is inaccurate in presence of ethane and the higher members of the series, and when these are present the washing with alcohol must be long continued. As it is a matter of great difficulty to retain hydrogen, even by the help of the most carefully ground stopcocks, the tests for this element were made in all cases at once after the arrival of the samples in the laboratory.

The olefines, as a group and carbon monoxide, are much more easily determined in natural gas than the paraffins and free hydrogen.

The olefines are quickly absorbed and removed by bromine water and carbon monoxide by a solution of cuprous chloride. These reagents are used in the order named. Unfortunataly, however, these fluids are likewise solvents, in less degree, for the paraffins,—ethane, propane &c. Hence a gas perfectly free from olefines and carbon monoxide is liable, on being washed with the above named fluids, to undergo a reduction in volume, leading to a wrong conclusion.

For the determination of these substances the following process was used, based on the solubility of both in a cuprous chloride solution. At the gas well a stream of gas was caused to bubble for two hours or more through 100 cubic centimeters of a solution of cuprous chloride. The solution was preserved for examination in the laboratory.

A quart flask, provided with a gas delivery tube and a funnel tube reaching to the bottom, was filled with boiled water and then the cuprous chloride, prepared as above described, was poured into the flask through the funnel tube. The flask was then heated to the boiling point and the water caused to boil for three hours. A small quantity of gas was invariably collected from the cuprous chloride solution by this treatment.

The gas so collected was transferred to an Elliott apparatus and carefully tested for olefines and carbon monoxide by bromine water and cuprous chloride solution. In this way the quantities of these two constituents in a very large quantity of gas could be collected in concentrated form, convenient for a qualitative test.

Carbon dioxide was determined by means of moist potash in a eudiometer over mercury, and also in the Elliott apparatus over water, by caustic potash solution. The latter method yields very correct results.

In addition to the determinations carried out in the laboratory, the gas at the well was caused to pass in a slow stream through lime water. The stream of gas was made approximately the same by using the same delivery tube, depth of lime water and shape of containing vessel, and by counting the number of bubbles per minute, and then noting the rapidity with which the lime water became milky.

For the detection of ammonia the gas at the well was caused to bubble through 100 c. c. of water, which had been carefully purified by distilling with addition of sulphuric acid and permanganate of potash. This water was afterwards tested by Nessler's solution, after the common method in use in the examination of drinking water, for ammonia.

The presence of exceedingly minute traces of ammonia could thus be shown with great accuracy. As solid masses of ammonium carbonate are reported to have been thrown out from the pipes leading from gas wells in the Murrysville field this test seemed very important.

In the statement of the results of analyses all gas volumes are to be understood as "normal,"—that is the volumes observed under different conditions of temperature and pressure are all reduced to zero, Centigrade, and 760 millimeters mercury pressure; and, where measured in a moist condition, are calculated as dry.

The temperatures were all measured by one and the same thermometer, of which the error was known from a comparison with the Yale Observatory standard. This thermometer was made by Green in New York and is divided to $\frac{1}{10}$ degrees centigrade.

The barometer used was made by Hicks, and indicated by vernier, changes of $\frac{1}{1000}$ inch. The constant error of this barometer was ascertained by comparison with the standard barometer of the Signal Service department, in Washington.

In all cases of gas measurements in eudiometers, the observations were made by means of a Grunow cathetometer, having a millimeter scale and vernier and reading easily to $\frac{1}{20}$ millimeter.

The etched scales upon the eudiometer tubes, as commonly supplied, are often very incorrect, both as regards uniformity and total length of scale, and are unsuited for accurate measurements of pressures or volumes.

The glass cylinders containing the gas samples for combustion were calibrated at a temperature not differing by one degree Centigrade from the temperature at which the gas was measured for analysis. In this way the calculation of errors due to expansion and contraction of the glass vessels was rendered unnecessary. This necessitated repeated calibrations after nearly every combustion.

In the calculation of the results of analyses, the following plan was adopted:

The percentage of Carbon dioxide was determined volumetrically. Having failed to find Carbon monoxide and olefines in any of the samples, they are necessarily left out of account in the calculation. Having found free hydrogen in only one of the gas samples, and here in traces, (Speechley,) it is also to be ignored in the calculations.

The quantities of carbon dioxide and water produced in the combustion of a known volume of gas were weighed. From the weight of the water the proportion of hydrogen in a unit volume of gas could then be calculated. The percentage volume of carbon dioxide contained in the gas being known, its weight was deducted from the weight of the total quantity obtained in the combustion. The difference is the quantity corresponding to carbon in the form of hydrocarbons. The nitrogen having been determined in a separate portion of gas, and the free hydrogen being also known, the volume of the hydrocarbons will be expressed by the following equation

$$\text{C \& H in form of hydrocarbons, . . } \} = 100-(CO_2+N+H+\text{etc.})$$

That is to say the actual volume of hydro carbons will occupy the entire space in the gas not occupied by CO_2, N, H, O, and other constituents of the gas.

No attempt has been made to determine the proportion of individual members of the paraffin series.—methane, ethane, propane &c, for the reason that no sufficiently accurate methods are known for the estimation of these bodies. No reagent can be named which will absorb and remove from a mixture any one of these paraffins exclusively, so as to allow of its correct determination by difference.

In such a mixture, moreover, no decided chemical change can be produced in any given paraffin without more or less altering the others. They are remarkable for the resemblance existing between them in chemical relationships, and also for the great resistance which they offer towards reagents of every description, excepting chlorine which attacks them all readily.

Moreover a calculation of the relative proportions of the gaseous hydro carbons of this class, based upon eudiometric data, is only possible where the number of such bodies is known to be limited to two,—a condition never to be assumed in a gas of unknown composition. In illustration of the fact just stated it may here be mentioned that a mixture of 1 volume each of methane, ethane and propane yields, on complete combustion, the same products and in the same proportions as three volumes of the intermediate hydrocarbon ethane. This can be shown by a very simple calculation.

Selection of Samples.

It was originally proposed to take samples from mains drawing gas from a group of wells and in this way obtain an average of the entire group. This was sometimes done as in the case of the Raccoon Creek and Speechley territories, where a large number of wells, all producing from one sand, are joined to one main. In other fields the wells are often drilled to different sands and produce gas from different horizons as in the case of the Kane wells. In many cases, among a large number of productive wells, all but two or three are shut in, and are thus held in reserve. In such instances a sample was taken at a single well, and directly from the main at the well.

Of the samples examined, No. 1 was taken at Fredonia, N. Y., by Mr. E. J. Crissey, Secretary of the Fredonia Natural Gas Light Co., from the mains of the company. All the other samples were collected by myself. In view of the great extent of the Pennsylvania gas territory, and the number of small areas of highly productive gas wells, the selection of samples with a view to an approximate average is a matter of no small difficulty. For the present purpose, and in the absence of any scientific criteria, reference has been had chiefly to the technical importance of certain regions, such as Murrysville and Speechley. Fredonia, N. Y., was chosen on account of the great depth (geologically) of the gas rock

Wilcox gas is remarkable for the long maintained high pressure exhibited in certain wells.

Baden and Raccoon creek lie on the same anticlinal.

Houston (Canonsburg) gas comes from a region 200 miles distant from the far Northern Fredonia gas field. All the samples are from regions where natural gas is being largely utilized on account of its fuel value.

Description of Samples.

No. 1. Fredonia, N. Y. From mains of the Fredonia Natural Gas Light Co., May 12th, 1887.

Mr. E. J. Crissey, Secretary of this Company, furnishes the following information :

Gas is obtained at an average depth of 200 feet. The rock is black and gray shale, alternating, to the depth of about 1000 feet, where a limestone is found. No gas has been found below 250 feet until a depth of between 1700 and 1800 feet is reached, when gas and salt water are met. At 2250 feet gas is again found, which burns with a very white flame, whiter than that of the shallow gas. The sample examined comes from the depth of 200 feet.

Two determinations of nitrogen in this gas gave 9.58% and 9.50% respectively. Mean, 9.54%.

In two determinations of carbon dioxide there were found 0.38% and 0.44%. Mean, 0.41%.

Results of Analysis of Fredonia Gas.

Nitrogen,	9.54 per cent.
Carbon dioxide,	0.41
Olefines,	0
Carbon monoxide,	0
Free hydrogen,	0
Ammonia,	0
Hydrocarbons of the paraffin series,	90.05
	100.00

343.47 cubic centimeters of Fredonia gas yield on combustion, by the method already described:

H_2O.—0.6254 gm., corresponding to, H—0.06964 gm=21.83 per cent.
CO_2—0.9144 gm., " " " C—0.24938 gm=78.17 per cent.
100.00

Making allowance for the 9.95% of nitrogen and carbon dioxide contained in the gas, it is calculated that the 90.05% paraffins present contain

Per liter.—0.80627 gm carbon.
0.22515 gm hydrogen.

In a second combustion of Fredonia gas 326.17 cubic centimeters yielded.

H_2O—0.5927 gm, corresponding to H—0.0660= 21.89 per cent.
CO_2—0.8635 gm, " " " C—0.2355= 78.11 per cent.
100.00

As these quantities of carbon and hydrogen belong exclusively to the paraffins in the gas, it is calculated that the paraffins—amounting to 90.05% of the total gas—will contain

Per liter.—0.80185 gm carbon.
0.2247 gm hydrogen.

In these calculations, as in the following, an allowance is made in the determination of the carbon for the very small quantity of carbon dioxide which always occurs in the original gas.

The means of the two results above cited are per liter of paraffins,—

0.80406 gm Carbon = 78.14 per cent.
0.22492 " Hydrogen= 21.86 per cent.
100.00

In the case of the Fredonia gas no tests were made at the wells. An actual test made at one of the wells in August, 1884, showed traces of oxygen. In the limited quantity at disposal for the above analysis no positively certain indication for oxygen could be obtained.

No. 2. From valve house close to well No. 1, of the Sheffield Gas Co., ½ mile from Sheffield. Warren Co., Pennsylvania. Wells No. 1, 2 and 3 were connected with the main at the time, so that the sample represents the average of the three wells.

Well No. 1 has been flowing since 1875; No. 2 was drilled two years later; No. 3. in 1885. The gas comes wholly from one and the same sand. The record of No. 1 is given on page 23 of Mr. Carll's Report on Warren Co. for 1883.

The sand from which these wells produce gas is about 1400 feet deep, and very nearly at ocean level.

The Sheffield Company own six wells. In the newer wells the pressure is even greater than in No. 1.

The pressure in No. 1 has remained constant since it was drilled, and amounts to 550lbs in 4 minutes when the gas is shut in.

In the Sheffield region there are about 64 square miles of gas-producing territory, and the gas pressure varies between 500 and 800lbs. per square inch.

The Sheffield gas wells supply Sheffield, Iona, Brookston, Clarendon, Warren, Corry, Erie and Jamestown, N. Y.

The wells in this region have been remarkably persistent.

Determinations of	(1)	(2)	Mean.
Nitrogen,	9.00	9.12	9.06 per cent.
Carbon dioxide,	0.33	0.27	0.30 per cent.

Results of Analysis of Sheffield Gas.

Nitrogen,	9.06
Carbon dioxide,	0.30
Oxygen,	Trace.
Hydrogen,	0
Olefines,	0
Carbon monoxide,	0
Ammonia,	0
Paraffins,	90.64
	100.00

305.27 cubic centimeters of Sheffield gas yield on combustion.

H_2O.—0.4960, corresponding to H,—0.05523 gm= 23.36 per cent.
CO_2 —0.6645, " " " C,—0.18123 gm= 76.64 per cent.

100.00

From these results it is calculated that the paraffins present in the Sheffield gas contain per liter:

0.65495 gm carbon.
0.19960 gm hydrogen.

In a second combustion, 314.44 cubic centimeters of Sheffield gas yield:

H_2O—0.5090 gm, corresponding to H,—0.05668 gm= 23.27 per cent.
CO_2—0.6851 gm, " " " C,—0.18684 gm= 76.73 per cent.

100.00

The paraffins will therefore contain per liter:

0.65557 gm carbon.
0.19887 gm hydrogen.

The means of these two analysis are per liter of paraffins:

0.65526 gm carbon = 76.69 per cent.
0.19923 gm hydrogen= 23.31 per cent.

100.00

No. 3.—Wilcox Gas Well, 3 miles from Wilcox, McKean Co. Sample collected Jan. 29, 1887. Originally known as "Wilcox well, No 1," now called No. 7. Was drilled in 1878, and produces gas from the fourth sand exclusively.

This well was the first in this region, and has maintained a continuous pressure of 500 ℔s. when shut in.

The United Natural Gas Co. own 24 wells in the Wilcox field, which occupies an area of about 2 miles square, No. 1 being in the southwest end. All are very productive, and some are remarkable for unusually high pressures, the gauge registering in one well 900 ℔s. All exceed 500 ℔s. Very little salt water is produced. The gas exhibits a decided oxygen reaction, turns lime water rapidly milky, and has a strong odor. Pipe lines carry the gas from these wells to Bradford, Jamestown, N. Y.; Hornellsville, Salamanca, Buffalo, but the supply is largely in excess of the demand at present.

Determination of	(1.)	(2.)	Mean.
Nitrogen,	9.32	9.50	9.41 per cent.
Carbon dioxide,	0.21	0.20	0.21 per cent.

Results of Analysis of Wilcox Gas.

Nitrogen,	9.41 per cent.
Carbon dioxide,	0.21
Oxygen,	trace
Carbon monoxide,	0
Olefines,	0
Ammonia,	0
Hydrogen,	0
Paraffins,	90.38
	100.00

374.2 cubic centimeters of Wilcox gas yield on combustion.

H_2O.—0.6022 gm, corresponding to H,—0.06706 gm=23.48 per cent.
CO_2.—0.8014 gm, corresponding to C,—0.21856 gm=76.52 per cent.
100.00

Hence 1 liter paraffins contains:

0.64622 gm carbon.
0.19828 gm hydrogen.

In the case of the Wilcox gas, an accident to some of the sample vessels prevented a second combustion, so that but a single result can be presented.

No. 4.—Kane well, No. 1, at Kane, McKean Co. Gas collected Jan. 30th, 1887.

The well was drilled in 1884. The pressure then was 550 ℔s when shut in for 40 minutes. It was allowed to blow off for 8 months, and then shut in, when the pressure increased to 630 ℔s. This gain in pressure has been permanent, up to October, 1886, when the last test was made. The Kane Natural Gas Co. own two other wells in addition to this. The gas exhibits decided oxygen and carbon dioxide reactions.

Determination of	(1.)	(2.)	Mean.
Nitrogen,	9.67	9.91	9.79
Carbon dioxide,	0.20	0.20	0.20

Results of Analysis of Kane Gas.

Nitrogen,	9.79 per cent.
Carbon dioxide,	0.20
Oxygen,	trace
Olefines,	0
Carbon monoxide,	0
Hydrogen,	0
Ammonia,	0
Paraffins,	90.01
	100.00

349.03 cubic centimeters of gas yield on combustion.

H_2O,—0.5600 gm, corresponding to H,—0.06236 gm=23.18 per cent.
C O_2—0.7580 gm, " " C,—0.20672 gm=76.82 per cent.
100.00

Hence 1 liter of the paraffins contains:

0.65801 gm carbon.
0.19849 gm hydrogen.

248.1 cubic centimeters of the same gas yield on combustion.

H_2O,—0.3987 gm, corresponing to H,—0.04439 gm=23.28 per cent.
C O_2,—0.5366 gm, " " C,—0.14634 gm=76.72 per cent.
100.00

Hence the paraffins of Kane gas contain per liter:

0.19883 gm hydrogen.
0.65537 gm carbon.

The means of these two analysis are per liter of paraffins.

0.65669 gm carbon = 76.77 per cent.
0.19866 gm hydrogen=23.23 per cent.
100.00

No. 5. Speechley. This field has been a remarkably productive one, as regards quantity and pressure of gas and number of wells. These wells are situated on a N. E. & S. W. line about 6 miles S. E. from Oil City.

The sand rock from which the gas is obtained averages 1900 feet in depth, and is about 900 feet below the third oil sand of Venango county.

This latter sand also produces gas, but in much smaller quantity, and it is consequently cased off, so that the gas in this territory is wholly obtained from one and the same sand rock. The Northwestern Gas Co. of Oil City have 60 wells, and a large number of wells are owned by other companies.

The samples of gas for examination were taken April 13th, 1887, from the high pressure main at South Oil City, belonging to the Northwestern Natural Gas Co. At this time the pressure in the main was 100 ℔s.

This sample may be considered to represent approximately the average of the gas from a large number of wells.

The tests at the main indicated the presence of oxygen, but less of carbon dioxide than found in the Warren and McKean county gas.

Determination of.	(1)	(2)	Mean.
Nitrogen, ...	4.61	4.41	4.51 per cent.
Carbon dioxide, ...	0.05	0.05	0.05
Hydrogen, ...	0.02	0.02	0.02

Results of Analysis of Speechley Gas.

Nitogen,.	4.51 per cent.
Carbon dioxide,.	0.05
Hydrogen, ...	0.02
Carbon Monoxide, ...	0
Olefins, ...	0
Oxygen, ...	trace.
Ammonia, ...	0
Paraffins,.	95.42
	100.00

304.24 cubic centimeters Speechley gas yield on combustion.

H_2O,— 0.5423 gm, corresponding to H,—0.06039 gm=22.93 per cent.
CO_2,—0.7441 gm, " " C,—0.20293 gm=77.07 per cent.
100.00

Hence the paraffins of this gas contain per liter

0,69900 gm Carbon
0,20801 gm Hydrogen

In a second combustion of the same gas, 310.52 cubic centemeters yield

H_2 O,—0,5500 gm, corresponding to H,—0.06125 gm=22.85 per cent.
CO_2 ,—0.7585 gm " " C,—0.20686 gm=77.15 per cent.
100.00

Hence the paraffins contain per liter:

0.20671 gm Hydrogen.
0.69815 gm Carbon.

In a second combustion, 306.28 cubic centimeters of gas yield

H_2O,—0.4818 gm, corresponding to H,—0.05365 gm=25.02 per cent.
CO_2,—05895 gm " " C,—0.16074 gm=74.98 per cent.
100.00

The means of these two results are per liter of paraffins:

0.69857 gm carbon = 77.11 per cent.
0.20736 gm hydrogen = 22.89 per cent.
100.00

No. 6. Hukill well, on the Dick Farm, Lyons Run District, southern end of Murrysville field, and one of 60 wells belonging to the Philadelphia Company.

This well was drilled in 1883 and was allowed to blow off for a long time. The well is very productive and has a pressure as it flows through the main of 285 ℔s.

The well has extra heavy casing and there is good reason to suppose that the gas comes exclusively from the Murrysville sand. The sample was taken April, 8, 1887.

The gas produces a decided carbon dioxide reaction but exhibits a very slight reaction for oxygen.

This gas has a very faint odor, free from the pungent character noticed among some of the gas samples. The well yields no oil, but a very little salt water.

Determinations of,	(1)	(2)	Mean.
Nitrogen,	2.13	1.91	2.02
Carbon dioxide,	0.26	0.30	0.28

Results of Analysis of Murrysville Gas.

Nitrogen,	2.02	per cent.
Carbon dioxide,	0.28	
Oxygen,	trace	
Oarbon monoxide,	0	
Olefines,	0	
Ammonia,	0	
Hydrogen,	0	
Paraffins,	97.70	
	100.00	

346,94 cubic centimeters of Murraysville gas yielded on combustion.

H_2O,—0.5473 gm, corresponding to H,—0.06095 gm= 25.06 per cent.
CO_2,—0.6682 gm, " " C,—0,18224 gm= 74.94 per cent.

100.00

Hence the paraffins in Murrysville gas contain per liter:

0,53763 gm Carbon.
0.17981 gm Hydrogen.

In a second combustion 306.28 cubic centimeters of gas yield

H_xO,—0.4818 gm, corresponding to H,—0.05363 gm=25.02 per cent.
CO_2—0.5895 gm, " " C,—0.16074 gm=74.98 per cent.

100.00

Hence the paraffins contain per liter:

0.53718 gm Carbon.
0.17922 gm Hydrogen.

The means of the above analyses are per liter of paraffins:

0.53741 gm Carbon = 74.96 per cent.
0.17950 gm Hydrogen = 25.04 per cent.

100.00

The following experiments were tried at the valve house of the Philadelphia Company, in the rear of the office building on Penn street, Pittsburg, beginning on March 22d, 1887. A Woulfe's bottle containing 200 c. c. purified water, and a second bottle containing cuprous chloride were connected with a gas meter, and gas allowed to stream slowly through them until 190 cubic feet had passed. The gas thus used comes directly from the Murrysville field. The gas was passed very slowly, so that 3 days were occupied in the transmission of the volume above named. The water was then tested for ammonia by Nessler's reagent No trace could be detected, although as is well known this reagent is capable of detecting $\frac{1}{200000000}$ part of ammonia in water, with great certainty.

The cuprous chloride was tested for both olefines and carbon monoxide by the method I have detailed, but no trace could be detected of either.

The composition of methane gas by weight is .

Carbon, ...	74.97 per cent.
Hydrogen, . . . , . .	25.03 per cent.
	100.00

Hence this Hukill well produces gas approximating in composition to pure methane, and in this respect differs from all those from which samples have been taken. It may be here stated that at the time the sample was collected there was every reason to believe that the gas came exclusively from this one well.

No. 7. Raccoon Creek District.

The sample was taken May 2d, 1887, from the high-pressure main of the Bridgewater Natural Gas Co. at Rochester, Pa. The pressure at the time was 67 fbs.

The gas is produced wholly from one sand, which is about 1200 feet below the surface on Raccoon Creek, in Beaver county. The Bridgewater Company owns 23 wells and supplies the towns of Beaver Falls, Rochester, New Brighton, Phillipsburg, Vanport, Bridgewater, New Sheffield, Shannopin.

The Youngstown Company own 12 wells in the same region. The gas is almost odorless, and the wells produce little or no salt water, and no oil.

On causing the gas to bubble through lime water for 20 minutes the fluid remained perfectly clear. After 40 minutes a rapid stream of gas caused the lime water to become faintly milky, as seen in a bright light. The proportion of carbon dioxide was far too small to allow of an accurate endiometric determination. The oxygen reaction was faint but decided.

This gas on being passed for one hour into a nitrate of silver solution produced a faint but decided reaction, indicating a trace of sulphuretted hydrogen.

In the statement below, the result of the carbon dioxide test at the main is given.

Determination of	(1)	(2)	Mean.
Nitrogen, ... ,.	10.00	9.82	9.91

Results of Analysis of Raccoon Creek Gas.

Nitrogen,	9.91 per cent.
Hydrogen,	0
Carbon dioxide,	trace.
Carbon monoxide	0
Olefines,	0
Oxygen,	trace
Ammonia,	0
Sulphuretted hydrogen,	trace
Paraffins,	90.09
	100.00

In a combustion of Raccoon creek gas 325.48 cubic centimeters yielded :

H_2O,—0.5108 gm, corresponding to H,—0.05688 gm= 23.60 per cent.
CO_2,—0.6755 gm, " " C,—0.18422 gm= 76.40 per cent.
100.00

Hence the paraffins in this gas contain per liter:

0.62827 gm carbon.
0.19398 gm hydrogen.

In a second combustion 398.08 cubic centimeters gas yielded

H_2O,—0.6254 gm, corresponding to H,—0.06964 gm= 23.56 per cent.
CO_2,—0.8286 gm, corresponding to C,—0.22598 gm= 76.44 per cent.
100.00

Hence the paraffins contain per liter:

0.63010 gm carbon.
0.19418 gm hydrogen.

The means of these two results are per liter paraffins:

0.62918 gm carbon = 76.42 per cent.
0.19408 gm hydrogen= 23.58 per cent.
100.00

This is the only gas which contains traces of sulphuretted hydrogen among those I have examined.

No. 8. Baden, six miles S. E. from Rochester on the Pittsburgh, Fort Wayne and Chicago R. R., Beaver county. The samples were taken May 18th, 1887, from the Bryan well, No. 2, one of the four wells belonging to the Baden Gas Co. The gas is produced wholly from one sand which is 1396 feet deep, or about 1300 feet below the Ohio river. This well was drilled in May, 1886.

The Baden wells are on the same anticlinal axis as the Raccoon creek wells. This same axis continues northward a few miles east of the Speechley wells near Oil City.

The gas exhibits a decided carbon dioxide and also an oxygen reaction.

Determinations of	(1.)	(2.)	Mean.
Nitrogen,	12.26	22.38	12.32 per cent.
Carbon dioxide,	0.41	0.41	0.41

Results of Analysis of Baden Gas.

Nitrogen,	12.32 per cent.
Carbon dioxide,	0.41
Oxygen,	trace
Hydrogen,	0
Carbon monoxide,	0
Olefines,	0
Ammonia,	0
Paraffins,	87.27
	100.00

317.17 cubic centimeters of Baden gas yield on combustion:

H_2O,—0.4892 gm, corresponding to H,—0.05447 gm= 23.48 per cent.
CO_2,—0.6510 gm, corresponding to C,—0.17754 gm= 76.52 per cent.
100.00

Hence the paraffins of Baden gas contain per liter:

0.64142 gm carbon.
0.19681 gm hydrogen.

In a second combustion 332.70 cubic centimeters yield:

H_2O,—0.5130 gm, corresponding to H,—0.05712 gm= 23.56 per cent.
CO_2,—0.6843 gm, corresponding to C,—0.18663 gm= 76.44 per cent.
100.00

Hence the paraffins contain per liter:

0.64276 gm carbon.
0.19674 gm hydrogen.

The means of these two results are per liter paraffins:

0.64209 gm carbon = 76.48 per cent.
0.19677 gm hydrogen= 23.52 per cent.
100.00

No. 9. Houston well, Houston station, 2 miles south of

Cannonsburg, on the Pittsburgh, Cincinnati and St. Louis R. R., Washington county.

This well is situated ⅛ mile west of the station on Plum run.

It is drilled nearly through the Gantz sand and is 1794 feet deep. An upper, gas producing, sand is found at 850 feet, but this is cased off so that the well may be considered to yield gas from the Gantz sand exclusively.

The gas from the upper sand is said by well superintendants to burn with a whiter but more sooty flame than that from the greater depth.

According to the statements generally heard at the wells, the occurrence of an upper, less productive gas sand, yielding gas of greater illuminating power, is a very common feature in many gas fields. The sample was collected on March 18, 1887.

The gas exhibits an oxygen reaction and causes a rapid precipitation in lime water.

Determination of	(1.)	(2.)	Mean.
Nitrogen, ...	15.23	15.37	15.30 per cent.
Carbon dioxide, ...	0.42	0.46	0.44

Results of Analysis of Houston Gas.

Nitrogen, ...	15.30 per cent.
Carbon, dioxide	0.44
Oxygen, ...	trace
Olefines, ...	0
Carbon monoxide, ...	0
Ammonia, ...	trace
Hydrogen, ...	0
Paraffins, ...	84.26
	100.00

310.20 cubic centimeters of Houston gas yielded on combustion.

H_2O,—0.4601 gm, corresponding to H,—0.05124 gm,= 23.20 per cent.

CO_2—0.6217 gm, " " " C,—0.16955 gm,= 76.80 per cent.

100.00

Hence the paraffins contain per liter:

0.64871 gm carbon.

0.19602 gm hydrogen.

In a second combustion 293.35 cubic centimeters yielded:

H_2O,—0.4392 gm, corresponding to H,—0.04891 gm= 23.44 per cent.
CO_2—0.5855 gm, " " " C,—0.15968 gm= 76.56 per cent.

100.00

Hence the paraffins contain per liter:

0.64604 gm carbon.
0.19786 gm hydrogen.

The means of these two analyses are per liter of paraffins:

0.64737 gm carbon = 76.68 per cent.
0.19694 gm hydrogen= 23.32 per cent.

100.00

The analyses above detailed were carried out with great care, and every known precaution observed in order to secure accuracy.

The results represent the character of the gas from particular wells or groups of wells, scattered over a large region, and as it flowed from the wells on a single day.

It is questionable whether they can be considered to represent the average composition of natural gas, for the reason that the gas territory is so vast in extent.

According to the above results natural gas is not so complex a substance as has been heretofore supposed.

The samples examined may be said to consist mainly of the hydro-carbons of the paraffin series, among which methane predominates.

It is to these bodies that the fuel value of the gas is due.

Inasmuchas most of the gas conveyed through pipe lines, deposits little or no liquid hydro-carbons, it is evident that the higher paraffins are not present in notable quantity.

The method I have used in testing for the hydro-carbons of the olefine series enables me to state with much confidence that these bodies,—ethylene, propylene, butylene, etc., are absent. Hydrogen I have found in Speechley gas alone, although the utmost care has been taken in the examination.

Perhaps still smaller quantities may have escaped detection in other gas samples.

Sulphuretted hydrogen was found only in Raccoon creek gas, but in faint traces.

Oxygen is present in all, but in such small quantities that I have never succeeded in accurately determining its real percentage.

As nearly as I can estimate, the Wilcox contains more oxygen than any other, and Murrysville the least.

Ammonia was found, in traces only, in Houston gas. Carbonic oxide was not found in any of the samples.

A comparison of the results in the accompanying table shows that the different gas samples differ mainly in the following particulars.

1.—The proportion of carbon to hydrogen in the contained paraffins—that is to say the ratio of the lower to the higher paraffins. Fredonia is seen to be the richest gas in carbon.

2.—The proportion of nitrogen, which varies between 2.02% and 15.30%. The three gas fields, Speechley, Baden and Raccoon Creek approximately on the same anticlinal (according to Mr. I. C. White) produce gas having very different quantities of nitrogen.

The resemblance between the Fredonia, Sheffield, Kane, Wilcox, and Raccoon Creek gas as regards the proportion of nitrogen is a matter of interest, although not explainable.

In the case of Murrysville, Speechley and Fredonia gas the density, richness in carbon, and calorific power of the contained paraffins are inversely as the proportion of nitrogen. It is a curious fact that there is a certain continuity as regards composition in the case of the Fredonia, Kane, Sheffield and Wilcox gases, which disappears on reaching the Speechley field, in proceeding southward. South of Speechley much greater differences occur.

3.—The carbon dioxide, which varies within very narrow limits. The only gas in which it almost disappears is that from Raccoon creek although Speechley gas contains barely more than a trace.

TABLE I.

CONSTITUENTS.	Freedonia.	Sheffield.	Kane.	Wilcox.	Speechley.	Lyons' run, near Murysville.	Raccoon creek.	Baden.	Houston.
Nitrogen,	9.54	9.06	9.79	9.41	4.51	2.02	9.91	12.32	15.30
Carbon dioxide,	0.41	0.30	0.20	0.21	0.05	0.20	trace	0.41	0.44
Hydrogen,	0	0	0	0	0.02	0	0	0	0
Ammonia,	....	0	0	0	0	0	0	0	trace
Oxygen,	trace	trace	trace	trace	trace	trace	trace	trace	trace
Sulphuretted hydrogen,	....	0	0	0	0	0	trace	0	0
Paraffins,	90.05	90.64	90.01	90.38	95.42	97.70	90.09	87.27	84.26
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
The paraffins contained in these gas samples have the following composition *by weight.*									
Carbon,	78.14	76.69	76.77	76.52	77.11	74.96	76.42	76.48	76.68
Hydrogen,	21.86	23.31	23.23	23.48	22.89	25.04	23.58	23.52	23.32
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

At Oil City a sand is found 582 feet below low-water mark in the Allegheny river, which produces gas of lower pressure, amounting, it is said, to 20 lbs. when shut in for some time. This gas is used in the Oil Well Supply Co's works for heating purposes. It bears the same relation to the Speechley gas sand—1900 feet deep—as the shallow gas sands usually to the deeper, and more productive sand rocks.

A determination of the nitrogen in the gas from this upper rock gave 5.62 per cent. Speechley gas contains 4.51 per cent. The sample was collected on April 13th, the day on which the Speechley samples were taken.

The Speechley gas wells are six miles distant from this well. Tests for hydrogen, olefines, carbon monoxide and dioxide and ammonia in this gas all led to negative results.

Calculation of the Fuel Value of Natural Gas.

The calorific power of any combustible may be determined by measuring the number of kilograms of water heated from 0° to 1° C. by 1 kilo of the fuel in burning, or by a calculation. The difficulties and inconveniences encountered in the first method necessitate commonly a resort to the second.

Pure charcoal in burning produces, according to the researches of Favre & Silbermann (in 1849), 8080 heat units, or 1 kilo in burning will raise the temperature of 8080 kilos of water from 0° to 1° C.

By the same authors it was found that 1 kilo of hydrogen in burning generates a quantity of heat sufficient to warm 34462 kilos of water from 0° to 1°C—that is 34462 heat units. Later determinations have been made by various authors, the most important being by Thomsen, who found 34180 (Berichte der Deutschen chemischen Gesellschaft, 1873, p 1533), and by Berthelot who obtained the number 34600, (Comptes Rendus, 1880 p 1240). The value assigned by Thomsen, viz: 34180, is probably the more correct.

If it were possible that a fuel should contain pure hydrogen and charcoal, *uncombined*, a calculation of its heating power would lead to very correct results. It is found, however, that when a *compound* of carbon and hydrogen is burned, the number of heat units produced will not equal the number obtained when the same quantities of carbon and hydrogen are burned separately.

Thus a kilo of methane produces 13270.5 heat units, but if the same quantities of carbon (as charcoal) and hydrogen were burned *separately* in a calorimeter, 14613 heat units result (assuming that the carbon produces 8080, and the hydrogen 34180 heat units per kilo burned).

The diffierence between the calculated amount of heat, and the actually available heat—14613—13270=1343 heat units is 9.19 per cent. of the theoretical yield. For practical applications this is a loss of heat, which must be considered to represent the quantity of energy required to overcome the mutual affinity of the carbon and hydrogen, which are to be first separated, before they are burned to carbon dioxide and water.

With more complex compounds the available heat of combustion does not fall so far short of the theoretical maximum, and it may be stated in a general way that the greater the number of carbon atoms in the compound, the more closely will the available and actual number of heat units coincide. This statement is especially true of certain series of hydrocarbons. The following table (II) will serve to illustrate this in the case of the first three members of the paraffin series. For the higher paraffins no determinations have yet been made.

TABLE II.—Showing Ratio of Available to Calculated Heat of Combustion in the case of certain Hydrocarbons.

NAME.	Symbol.	Calculated heat units, assuming that the carbon and hydrogen produce the maximum of heat, and are burned separately. Per kilo of paraffin.	Available heat as determined by calorimetric measurement. Per kilo of paraffin.	Percentage of available on theoretical maximum of heat units.
Methane, ...	CH_4	14613	13270	90.81
Ethane, ...	C_2H_6	13310	12373	92.95
Propane, ...	C_3H_8	12835	12052	93.89

It has been shown by Thomsen that isomeric hydro carbons, or those which differ in properties, although having identical composition, may produce different quantities of heat when burned, thus:

	Symbol.	Heat Units.
Propylene, ...	$C_3 H_6$	11757
Trimethylene, ...	$C_3 H_6$	10917
	Difference =	840

The chemical formulas given show them to have the same composition, and yet these hydrocarbons would be represented by different values if used as fuels.

The presence of isomers among the hydro carbons of natural gas would tend to interfere with the correctness of a calculation of its fuel value.

No isomers are known in the case of methane (CH_4).

Berthelot has stated that a second hydro carbon isomeric with ethane (C_2H_6) exists, which produces on burning 12776 heat units, instead of 12373, the number as determined by Thomsen.

Thomsen's researches have disproved this assertion, however, and have shown conclusively that ethane produced in a variety of ways invariably possesses the same calorific power. (Berichte der Deutschen chemischen Gesellschaft 1881, p 500). Isomers of the higher paraffins no doubt occur in gas, as well as in petroleum, but when it is considered that in gas the higher paraffins occur only in small quantity, and moreover that the calculated and the available calorific power differ much less in these higher members than in methane and ethane, the danger of error from the presence of such isomers cannot be considered likely to affect the calculated results.

The calorific power of methane was determined by Andrews in 1848 as 13108 heat units (Philosophical Magazine 1848 p 321), and by Favre and Silbermann in 1853 as 13063. heat units.

In 1880 Thomsen assigned it the value 13345.6, and this number agrees closely with that obtained by Berthelot in the same year, viz: 13343.8. More recently Thomsen has corrected his former result, and now gives 13270.5 as the most probable number. (Berthelot, Comptes Rendus, 1880 p 1240. Thomsen, Berichte der Deutschen Chemischen Gesellschaft 1880, p 959 and 1321 Ref, and 1886 p 77, Ref.).

The elaborate researches of Julius Thomsen in thermochemistry, (Thermochemische Untersuchangen, Leipzig) have reached the fourth of a series of large volumes, and although designed primarily as a contribution to theoretical chemistry, they supply data likely to prove of great value in the study of fuels for metallurgical and other technical purposes.

The actual calorific power of a gas fuel may now, by the use of such data, be more satisfactorily determined by calculation, provided its composition is known, than by the use of a calorimeter. In this respect there is an important difference between gas fuels and the various kinds of coal. Coal being a compound of carbon, hydrogen and oxygen, of a highly complex chacacter, or possibly a mixture of such compounds, no such plainly definable relationship exists between the theoretical maximum and the available heat quantity per unit weight burnt.

The percentage composition by weight of the paraffins likely to occur in natural gas is expressed in the following table. Small quantities of condensible vapors of the higher paraffins occur in the gas in some places as is evidenced by the condensation of benzene in pipes. These heavier vapors occur usually in very minute quantity, if at all:

TABLE III.—Showing the Composition by weight of some of the Lower Paraffins.

NAME.	Symbol.	Per cent. carbon.	Per cent. hydrogen.
Methane, ...	CH_4	74.97	25.03
Ethane, ...	C_2H_6	79.96	20.04
Propane, ...	C_3H_8	81.78	18.22
Butane, ...	C_4H_{10}	82.72	17.28
Pentane, ...	C_5H_{12}	83.29	16.71

The analyses of natural gas above detailed show a variation in the proportion of carbon and hydrogen in the case of the two extremes of 3.18 per cent., thus:

The paraffins in Murrysville gas contain—

Carbon, ...	74.96	per cent. by weight.
Hydrogen, ...	25.04	" " "
	100.00	

And in the case of Fredonia gas—

Carbon, ...	78.14	per cent. by weight.
Hydrogen, ...	21.86	" " "
	100.00	

From the tabular statement of the composition of the lower paraffins, it appears that Murrysville gas, as obtained at the Hukill well, has nearly the composition of methane, while disregarding again the nitrogen and carbon dioxide present, the Fredonia gas, the richest in carbon, approximates in composition to a mixture of equal volumes of methane and ethane, of which the actual composition would be, by weight:

Carbon, ...	78.22	per cent.
Hydrogen, ...	21.78	per cent.
	100.00	

By this I do not imply that it actually contains these two paraffins in the proportion named, for it is possible that the gas in question contains more of methane and a very small quantity of some one of the higher paraffins, propane, or quartane, etc.

As I have stated in regard to the analyses, the exact determination of the percentage of individual paraffins is a matter of such extreme difficulty, that it may be considered practically impossible.

If we assume that Fredonia gas really contains equal volumes of methane and ethane, and calculate its calorific power accordingly, the following error may be committed. The gas may contain a larger amount of methane than was assumed, and consequently a very small quantity of quartane or pentane, *for although the percentage of carbon and hydrogen is definitely fixed by the analysis, it is still a question as to the arrangement of the carbon and hydrogen in the form of higher or lower paraffins.*

As the difference between the available and the theoretical heat of combustion is greater in the case of methane and less and less in the higher paraffins, an under estimate of the quantity of methane would lead to too high a value for the available heat of combustion. On the other hand, an under estimate of the proportion of the higher paraffins, would cause the available heat, as expressed in heat units, to be rated too low, supposing that in both cases the absolute quantities of carbon and hydrogen remain constantly the same.

This error would be small in most instances, but in the extreme case of 2 gases consisting of methane and ethane respectively, the error from this source would exceed 1%. I have attempted to correct this error, as will be shown below. The curious and intimate relationships of the paraffins are well illustrated by the fact that a mixture of 1 cubic meter each of methane, ethane and propane will contain the same proportions of carbon and hydrogen, and will consequently yield the same quantities on burning of $C O_2$ and $H_2 O$ as three cubic meters of the intermediate hydro-carbon, ethane,—

1 cubic meter of methane weighs 0.7148 kilo, and generates heat units,	9485
1 cubic meter of ethane weighs 1.34016 kilo, and generates heat units,	16582
1 cubic meter propane weighs 1.9656 kilos, and generates heat units,	23688
	49755
3 cubic meters of ethane generate on burning heat units,	49746
	9

The numbers expressing the heat produced are obtained by multiplying the weight of the cubic meter by 13270, 12373 and 12052, respectively, as given in table II.

The difference is so slight—amounting to only 9 heat units, that it is evident that it would have been sufficiently accurate to assume this mixture of three hydro-carbons to consist of the intermediate member Ethane in so far as the calculation of the fuel value is concerned.

Or it may be more broadly stated that, with a view to the calculation of the calorific power of natural gas, it is sufficiently accurate to assume that a natural gas, (containing no hydro-carbons of the olefine series) has the simplest constitution consistent with its percentage by weight of carbon and hydrogen, and then to determine its fuel value accordingly.

Fredonia gas, as shown in the table of analyses, consists of 90.05% of paraffins, together with 9.54% nitrogen and 0.41% carbon dioxide. The paraffins consist of 0.80423 kilo carbon and 0.22494 kilo hydrogen per cubic meter.

The theoretical maximum of heat units for these paraffins is calculated as follows, per cubic meter:

0.80406×8080, ... 6497
0.22494×34180, ... 7288

13785

When $C H_4$ burns, only 90.81% of the theoretical heat is available. When $C_2 H_6$ burns 92.95% can be utilized.

Hence if Fredonia gas is to be looked upon as a mixture of equal volumes of the two hydro-carbons methane and ethane, it will contain about 1 and 1.87 parts by weight respectively, (or approximately two parts by weight) of methane and ethane.

The available heat of combustion can be determined by multiplying the theoretical maximum by a factor which is intermediate between $\frac{90.81}{100}$ and $\frac{92.95}{100}$, and as a very close approximation the fraction

$$\frac{2\,\mathrm{Et} + \mathrm{Mt}}{3 \times 100}$$

will, I think, be sufficiently accurate. In this Et = the percentage of available on theoretical maximum heat, for ethane and Mt = the same ratio for Methane.

Substituting in this fraction

$$\frac{2 \times 0.9295 + 0.9081}{3} = .9224.$$

The theoretical maximum heat of combustion of the Fredonia gas, as calculated above, is 13785 heat units per cubic meter of contained paraffins.

Then 13785×0.9224=12715 as the available heat units due to the paraffins in the gas. As there are 90.05% of paraffins, the remainder, consisting of nitrogen and carbon dioxide, the above number will be still further reduced, and $12715 \times 0.9005 = 11450$, = the available heat produced by 1 cubic meter of Fredonia gas.

In the case of the gas from Sheffield, Kane, Wilcox, Raccoon Creek, Baden and Houston, there is a general similarity as regards the percentage of carbon and hydrogen. Wilcox gas may be regarded as representing approximately the average, and as a calculation shows that a mixture of 4 volumes methane and 1 volume ethane contains carbon 76.54 and hydrogen 23.46, we may, for the purpose of the present calculation, assume that the above mentioned six gases contain approximately these proportions of the two named paraffins. For such a mixture the factor by which to obtain the available calorific value will be

$$\frac{2\,\mathrm{Mt} + \mathrm{Et}}{3 \times 100} = 0.9153.$$

This factor has accordingly been used in the case of the above named gases. Speechley gas may be considered to contain 5 volumes of Methane and 2 volumes of Ethane for the purpose of the present calculation, and the factor will be

$$\frac{3\,\mathrm{Et} + 4\,\mathrm{Mt}}{7 \times 100} = 0.9173.$$

Murrysville gas contains nearly pure methane, and consequently the factor will be 90.81.

It is not implied in the above considerations that the actual proportions of what may be regarded as the most commonly occurring paraffins,—CH_4, C_2H_6, C_3H_8, etc., can be accurately stated, for this I believe to be impossible. These proportions have been assumed as not inconsistent with the analytical data, merely for the purpose of obtaining an approximately correct value for the factor to be used in the calculation of the calorific power of the gas. The following table (IV) contains the results of the calculations carried out as explained. Column No. 2 in this table expresses the quantities of carbon and hydrogen contained in 1 cubic meter of the paraffins in each gas. In column No. 3 are given the factors, the derivation and use of which have already been pointed out:

TABLE IV.—Fuel Values of Natural Gas.

GAS FIELD.	WEIGHT IN KILOGRAMS PER CUBIC METER OF PARAFFINS.		Factor.	Available heat units per cubic meter of gas.	Available heat units per 100 cubic feet of gas.	Pounds of water at boiling point evaporated by 100 cubic feet of gas.	Pounds of pure charcoal equal in heating effect to 100 cubic feet of gas.
	Carbon.	Hydrogen.					
Fredonia,	0.80406	0.22492	0.9224	11449	32421	133.30	8.845
Sheffield,	0.65526	0.19924	0.9152	10040	28430	116.89	7.756
Kane,	0.65669	0.19866	0.9152	10354	29319	120.54	7.990
Wilcox,	0.64622	0.19828	0.9152	9925	28102	115.54	7.667
Speechley,	0.69857	0.20736	0.9173	11144	31554	129.73	8.609
Lyon's Run, near Murrysville,	0.53741	0.17950	0.9081	9296	26321	108.22	7.181
Raccoon Creek,	0.62918	0.19408	0.9152	9661	27355	112.47	7.463
Baden,	0.64209	0.19677	0.9152	9515	26941	110.77	7.350
Houston,	0.64737	0.19694	0.9152	9224	26119	107.38	7.126

This factor is a fraction. Its numerator represents the actual number of heat units produced in the burning of the unit weight of the total paraffins, from a consideration of the percentage of carbon and hydrogen in the gas. The denomenator represents the number of heat units obtained when the quantities of contained carbon and hydrogen are multiplied by the numbers 8,080 and 34,180 respectively, and the products added.

Column No. 4 gives the actual fuel value of each gas expressed in heat units per cubic meter. These numbers represent the heat of combustion calculated for the carbon and hydrogen separately, these two added together, and their sum multiplied by the corresponding factor in column No. 3.

The numbers in column No. 5, indicate kilograms of water which can be warmed from 0° to 1° C, when 100 cubic feet of the respective gas, measured at 0° C and under a barometric pressure of 76 centimeters, is burned at an initial temperature of 18°C, or 64.4°F; (this last is the temperature assumed by Thomsen in his determinations,) and assuming that the products of combustion are liquid water and gaseous carbon dioxide.

In column 6 are stated the number of pounds avoirdupois of water which, theoretically, should be boiled away at 100°C. into steam at the same temperature, and under atmospheric pressure, when 100 cubic feet of gas are burned. The latent heat of evaporation of water in this calculation has been assumed as 536.2 heat units. (Berthelot, Compts Rendus, 1877, p. 646.)

In a seventh column a comparison is given between gas and pure charcoal, assumed free from ash.*

Charcoal has been chosen rather than coke or coal, for the reason that exact calorimetric data as to the latter fuels are as yet difficult to obtain, and calculated values are uncertain.

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*As already stated the heat unit employed in the above calculations is the quantity of heat required to warm 1 kilogram of water from 0° to 1°C.

The plan of statement of results I have adopted will render it an easy matter, however, to substitute any other units or calorimetric values.

An impression prevails, based partly upon analytical data, and partly upon a supposed variation in the steam-producing power, that natural gas is subject to constant fluctuations in composition. To what extent such fluctuations are liable to affect the value of the results of the above calculations, I am wholly unable to state.

In conclusion I have to express my indebtedness for information and for facilities in conducting tests and examinations at wells to the following gentlemen: Mr. K. Chickering, of the Oil Well Supply Co., Oil City; Mr. W. C. Henry, of the United Natural Gas Co., Wilcox; Mr. Walter Horton and Mr. John McNair, of Sheffield; Mr. J. D. Bruder, of Kane; Mr. E. J. Crissey, of Fredonia; Mr. T. F. Gayley, of Rochester, and to the officers of the Philadelphia Gas Co., the Baden Gas Co. and the Pennsylvania Gas Co. of Pittsburgh, and to many others.

List of Books, Papers and References on Rock Oil and Gas.

Extracted from U. S. Census Report, 1880, Vol. X, pp. 281.

Mr. B. S. Lyman, geologist, appointed by the British government to report on the Oil Fields of the Punjab, in Upper India, and afterwards Director of the Geological Survey of Japan, prepared a Bibliography of Petroleum in 1875, which he presented to the Geological Survey of Pennsylvania. Prof. S. F. Peckham, Special Agent for reporting on Petroleum and its Products to the Bureau of the United States Census, of 1880, requested and obtained permission to use Mr. Lyman's list in the preparation of a more complete Bibliography brought up to the date of the publication of his report. Mr. Lyman's authors with one or two later additions by him are designated by an asterisk (*). Prof. Paul Schweitzer, of the University of Missouri, published a list in 1879, which is also incorporated in Prof. Peckham's list.

The following are the abbreviations used instead of the full titles of Transactions and Proceedings of Societies, Scientific Journals and Magazines, &c., in which special treatises on the subject have been published.—[J. P. L.]

Abbreviations.

A. C. et P.	Annales de Chimie et de Physique.
A. C. u P.	Annalen der Chemie und Pharmacie.
A. der P.	Archiv der Pharmacie.
A. J. Ph.	American Journal of Pharmacy.
A. J. S.	American Journal of Science and Arts (Silliman's Journal.)
Am. C.	American Chemist.
Am. J. G. L.	American Journal of Gas Lighting.
An. G. C.	Annales du Génie Civil.
An. M.	Annales des Mines.
A. of P.	Annals of Philosophy.
A. S. D.	Annual of Scientific Discovery.

B. D. C. G.	Berichte der Deutschen Chemischen Gesellschaft zu Berlin.
B. I. u. Gbl.	Bayerisches Industrie- u. Gewerbeblatt.
B. N. A. W. M.	Bulletin of the National Association of Wool Manufacturers.
B. S. C. P.	Bulletin de la Société Chimique de Paris.
B. S. d'E.	Bulletin de la Société d'Encouragement.
B. S. G. F.	Bulletin de la Société Géologique de France.
B. u. H. J.	Leobener Berg- und Hütten-Jahrbuch.
B. u. H. Z.	Berg-und Hütten-Zeitung.
Bull. A. I. St. P.	Bulletin de l'Académie Impériale des Sciences de Saint-Pétersbourg.
C. Cbl.	Chemisches Centralblatt.
C. Ind. Z.	Chemische Industrie-Zeitung.
C. N.	London Chemical News.
C. Nat.	Canadian Naturalist.
C. R.	Comptes-Rendus des Séances de l'Académie Française.
C. Z.	Chemische Zeitung.
D. Ill. G. Z.	Deutsche Illustr. Gewerbe-Zeitung.
D. Ind. Z.	Deutsche Industrie-Zeitung.
Dingler.	Dingler's Polytechnisches Journal.
E. M. W. S.	English Mechanic and World of Science.
Eng.	Engineering.
F. Gztg.	Fürther Gewerbezeitung.
G. Ind.	Génie Industriel.
H. Gbl.	Hessisches Gewerbeblatt.
Hübner's Z.	Hübner's Zeitschrift für die Paraffin-, Mineralöl-, und Braunkohlen-Industrie.
Ind. B.	Industrie-Blätter.
Int. Obs.	Intellectual Observer.
J. A. S. B.	Journal of the Asiatic Society of Bengal.
J. C. S.	Journal Chemical Society of London.
J. F. I.	Journal of the Franklin Institute.
J. f. P. C.	Journal für Praktische Chemie (Erdmann's Journal).
J. G. B.	Journal für Gasbeleuchtung.
J. K. K. G. R.	Jahrbuch der K. K. Geologischen Reichsanstalt.
J. S. A.	Journal of the Society of Arts.
L'A. S. et I.	L'Année Scientifique et Industrielle.
Le Tech.	Le Technologiste.
L. J. G. L.	London Journal of Gas Lighting.
L. u. B. J.	Leonhardt und Bronn Jahrbuch.
Mem. A. A.	Memoirs American Academy of Arts and Sciences, Boston.
M. P. L. S.	Proceedings of the Manchester Philosophical and Literary Society.
M. Sci.	Moniteur Scientifique.
N. E. P. J.	New Edinburg Philosophical Journal.
N. J. Ph.	Neues Jahrbuch für Pharmacie.
N. Z. R. I.	Neue Zeitschrift für Rübenzucker Industrie.
Oest Z. f. B. u. H.	Oesterreich, Zeitschrift für Berg- und Hüttenwesen.
P. A. A. A. S.	Proceedings of the American Association for the Advancement of Science.
P. A. Ph. A.	Proceedings of the American Pharmaceutical Association.

P. A. P. S.	Proceedings of the American Philosophical Society, Phila.
P. B. A. A. S.	Proceedings of the British Association for the Advancement of Science.
P. C. A S.	Proceedings of the California Academy of Science.
P. G. S.	Proceedings of the Geological Society, London.
Pharm. Cbl.	Pharmaceutisches Centalblatt.
Ph. J.	Pharmaceutial Journal, London.
P. I. C. E.	Proceedings of the Institution of Civil Engineers, London-
P. J.	Philosophical Journal.
P. M.	Philosophical Magazine.
Pog. An.	Poggendorf's Annalen der Physik.
Poly. Cbl.	Polytechnisches Centralblatt.
Poly. Nbl.	Polytechnisches Notizblatt.
P. R. I.	Proceedings of the Royal Institution.
P. R. S.	Proceedings of the Royal Society.
P. S. M.	Popular Science Monthly.
P. T.	Philosophical Transactions of the Royal Society.
Q. J. G. S.	Quarterly Journal of the Geological Society of London.
R. C. A.	Repertoire de Chimie Appliquée.
R. I.	Revue Industrielle.
R. U. M.	Revue Universelle des Mines.
Sci. Am.	Scientific American.
S. M. & Sci. P.	San Francisco Mining and Scientific Press.
S. P. Z.	Schweiz. Polytechnische Zeitschrift.
T. A. I. M. E.	Transactions of the American Institute of Mining Engineers.
T. A. Ph. A.	Transactions of the American Pharmaceutical Association.
T. G. S.	Transactions of the Geological Society, London.
T. P. S. E.	Transactions of the Pharmaceutical Society, (English).
Trans. Am. P. S.	Transactions of the American Philosophical Society.
Trans. R. S.	Transactions of the Royal Society.
W. B.	Wagner's Berichte.
Z. A. C.	Zeitschrift für Analytische Chemie.
Z. A. O. A.	Zeitschrift des Allgemeinen Oesterreich. Apotheker-Vereins.
Z. C.	Zeitschrift für Chemie.

The few abbreviations of the titles to other journals are extended so as to need no reference.

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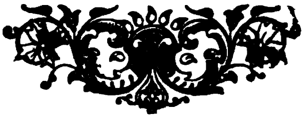
NOTE.—It is hoped during the coming winter to continue this list and bring it up to date, so as to publish it in a future volume. Any omissions or corrections suggested will be thankfully received at the Survey Office, 907 Walnut street, Philadelphia.



INDEX.

A.

Page.
Acme Gas Co's. pipe line to Braddocks, . . . 602
" " " " " notes on, . . . 676
" " " gas piped by, . . . 675
Allegany co., N. Y., first well in, . . . 601
" " " " operations in 1886, . . . 618
" " " " oils from older rocks than Venango oil group, . . . 663
" " " " sections in, . . . 639
" " " " well records in, . . . 774
Allegheny co., Pa., developments in, . . . 604
" " " list of wells in, . . . 690
" " " notes of wells in, . . . 664
" " " well records in, . . . 730
" river, elevations on, . . . 608
" salt wells, Nos. 1 and 2, notes on, . . . 665
American Manufacturer, table of companies in 1886 from, . . . 693
American well drilled for salt, . . . 589
Ammonia in Houston gas, . . . 814
" " natural gas, determination of, . . . 797
" test for, in Murrysville gas, . . . 808
Analysis of Baden gas, . . . 810
" Fredonia gas, . . . 800
" Houston " . . . 812
" Kane " . . . 804
" Murrysville gas, . . . 807
" natural " method of, . . . 793
" Raccoon creek " . . . 809
" Sheffield " . . . 802
" Speechley " . . . 805
" Wilcox " . . . 803
Anderson, David, experiments with oil as a lubricator, . . . 598
Anderson well, notes on, . . . 686
Angel belt line, . . . 600
Angier, T. D., first oil lease, . . . 595
"Anonontons," Indian name of petroleum, . . . 575
Area of counties, . . . 605
Armstrong county, developments in, . . . 603
Asa Say well, notes on, . . . 671
Associated Producers Co.'s Triangle well, . . . 767
" " " well No. 12, Kennedy farm, . . . 715
Avenue well, notes on, . . . 686

B.

Page.

Baden gas, analysis of, ... 810
“ “ Co., acknowledgment of assistance rendered by, ... 827
Balph farm, record of well on, 16½° W. from St. Joe, Butler co., ... 713
Bandy farm, well on, ... 684
Barbadoes' tar, ... 581
Barclay's well, Wellsburg, W. Va., ... 783
Barometer used in gas analysis, ... 797
Bayard, Mr., old salt well record by, ... 667
Bayard or Elrod well, Allegheny co., notes on, ... 667
Beatty's farm, record well No. 2, on, ... 719
Beaver co., developments in, ... 603
“ “ list of companies, ... 693
“ “ “ wells in, ... 692
“ “ wells, notes on, ... 689
“ “ “ records in, ... 779
Beaver gas field, ... 634
“ valley well, Mehaffey, J. A., ... 727
Bellevernon gas well No. 1, Fayette co. 778
Benton, Geo. L., authority for well record, ... 707
Berea Grit, produces oil and gas, ... 613
Best, Mr., authority for well record, ... 702
Best well, No. 1, record of, ... 702
Bibliography of Petroleum, ... 828
Big Beaver river, elevations on, ... 610
Big Level divide, ... 611
Big Sandy creek, elevations on, ... 609
Bingham's farm, record well No. 3, on, ... 719
Birchfield, P., authority for well record, ... 711
“ “ supt. Fisher Oil Co., ... 712
Bissell, G. H., sale of first oil property, ... 595
Bissell well, Allegheny co., ... 751
Blackadore's farm, Westinghouse well No. 6, on, ... 669
Blacks farm, record of well No. 4, ... 720
“ well, McKeesport, notes on, ... 667
“ “ J. B. Soles' farm, ... 750
Blocks of Sharon—Olean conglomerate, ... 636
Boice well, ... 776
Bone, J. H. A., petroleum used for lubricator, ... 593
Bonham, J. M., authority for well record, ... 704
Bonus for oil leases, ... 597
Booth, Prof., analysis of petroleum, ... 594
Boughton's well, record of, ... 709
Boulton & Doubleday's well No. 1, notes on, ... 673
“ “ Nos. 1 and 2 wells, notes on, ... 675
“ “ well, No. 1, Joshua Cooper's farm, ... 724
“ “ “ No. 3, notes on, ... 674
Bovard's well, Butler co., ... 720
Bowditch, E. E., leases Penn'a Rock Oil Co's. property, ... 597
Boyle, P. C., authority for well records, ... 702
Bradford district, operations in 1886, ... 619

Page.
Bradford, section at, ... 640
Bradford third sand, ... 614
Brady twp., Butler co., position of first oil sand in, ... 662
" " section in, ... 648
Breckenbridge tract, well on, ... 686
Breckenridge & Anderson's well, notes on, ... 687
Brewer, F. B., first oil company, ... 596
Brewer, Watson & Co., first oil lease, ... 595
Bridgewater, Gailey Bro's. well, notes on, ... 689
" wells, Nos. 1 and 4, ... 688, 689
" Gas Co., wells owned by, ... 688, 689
"British oil," 590
Brokenstraw creek, ... 609
Brookville well, No. 2, Jefferson co., ... 771
Bruce farm, well on, ... 688
Bruder, J. D., assistance rendered by, ... 827
Brushton sta., P. R. R., Hamilton well at, ... 671
Bruyas, James, missionary on the Mohawk, ... 810
Bryan's well, No. 2, analysis of gas from, ... 577
Bryce, Higbee & Co's. table glass works, pipe line to, ... 676
Buchanan's well, Cross Creek twp., ... 755
" " location of, ... 679
Buck, W. J., paper on early history of oil, by, ... 576
Buffalo pipe line, ... 633
Bullion run, section at, ... 647
" " position of first oil sand at, ... 662
Burksville, Ky., American salt well at, ... 589
Butler county, developments in, ... 608
" " well records in, ... 711
" district, operations in 1886, ... 621
" Gas Co.'s well, No. 1, Sarah McCandless farm, ... 715
" gas field, ... 634
" gas sand, ... 613

C.

Calculation of the fuel-value of natural gas, ... 816
Calorific power of methane, ... 819
Campbell's well, notes on, ... 686
Canonsburg gas well, Washington co., ... 762
Cannon's well, Pittsburgh, notes on, ... 666
Carbon dioxide in natural gas, ... 790
" " " " " determination of, ... 793
Carlisle's well, John Carlisle's farm, Mt. Pleasant twp., ... 760
" " location of, ... 680
Carpenter's Natural Gas Co., Hukill well, ... 725
Carpenter Nat. Gas Co., Hukill well No. 1, ... 724
" " " " notes on wells of, ... 678
" " " " No. 1, Thos. Martin's farm, ... 726
" station, well levels at, ... 675
" well, Garrard farm, Greene co., ... 774
Cary, Mr., early settler on Oil creek, collects oil, ... 590

Page.
Catskill formation described, . . . 640
Chance, H. M., measurements in Butler co., . . . 647
Characteristics of Venango oil group, . . . 616
Charlestown, W. Va., first drilled salt well near, . . . 588
Charlevoux, journal describing oil region, . . . 576
Chartiers Natural Gas Co., notes of wells and lines of, . . . 680
Church run, position of first oil sand at, . . . 662
Chemung formation described, . . . 640
Chess, Cook & Co's. well, Pittsburgh, notes on, . . . 666
Chickering, K., assistance rendered by, . . . 827
Christs, Fred, farm, well on, . . . 685
Church run, section at, . . . 642
Citizens' Natural Gas Co., Washington, notes of well of, . . . 682
City of Pittsburgh, notes of well in, . . . 664
City poor farm's buildings, pipe lines to, . . . 676
Clarendon, first well at, . . . 601
Clarion co., developments in, . . . 603
" " small well in, . . . 599
" district, operations in 1886, . . . 621
" river, elevations on, . . . 608
Clark, D. W., authority for well record, . . . 706
Classification of rocks based on color unreliable, . . . 645
Coal bed near base of conglomerate, . . . 637
Coe farm, well on, . . . 683
Cogley run pool discovered, . . . 602
College Hill quarries, . . . 637
Columbiana county, Ohio, well records in, . . . 784
Columbia Oil Co. well No. 1, . . . 717
Composition of the lower paraffins, . . . 820
Conemaugh river, elevations on, . . . 608
Conewango creek, elevations on, . . . 610
Conglomerate series sometimes produces oil and gas, . . . 613
Conkle, F. A., authority Craig's well No. 1, . . . 716
Conoquenessing sandstone absent at Washington, . . . 658
Continental divide, . . . 606
Cooper, Joshua, farm, wells on, . . . 675
" " " Lyon's run, B. & D. well No. 1, . . . 724
Cooper sand, . . . 614
Cornplanter, Seneca chief, . . . 586
" lands granted to, . . . 581
Cornwall well No. 2, record of, . . . 703
Coudersport, section at, . . . 644
Counties arranged in order of production, . . . 603
Craig, S. A., authority, Brookville well No. 2, . . . 777
Craig well No. 1, Rivers farm, . . . 716
Crandall's farm, Triangle well No. 1, . . . 774
Crane run well, record of, . . . 709
Crawford county, developments in, . . . 603
Crissey, E. T. acknowledgment of assistance rendered by, . . . 827
" " obtains samples of Fredonia gas for analysis, . . . 800
Crocker, F., authority, McGuigan's gas well No. 1 record, . . . 754

Page.
Crocker, F., Buchanan well record, ... 755
Crull, Campbell & Co., well record of, ... 704
Cryder No. 1 well, notes on, ... 674
Cuba oil springs, ... 576, 775
" " " described by Prof. Silliman, ... 591
Cumming, F., describes early method of collecting oil, ... 587

D.

Daillon, J. D., early mention of oil, ... 575
Darlington's well, Darlington, Beaver co., ... 780
Daum's farm, Hukill well No. 2, ... 725
" " well notes on, ... 678
" John, farm, McJunkin & Co.'s well No. 1, ... 718
De Celeron's expedition to Lake Erie, ... 577
Demmler station, well near, ... 667
Deposition of the oil group of rocks, ... 655
Dickinson, John, letter about oil written to, ... 580
Dick's farm, Hukill well No. 1, ... 724
" " well, notes on, ... 678
Dillworth's well, notes on, ... 670
Dimick, Geo. H., authority for well record, ... 698
Dividing line between Pocono, Catskill and Chemung, ... 639
Dollier and Galinee, map made by, ... 576
Donaldson's well, Mt. Pleasant township, ... 760
" " location of, ... 680
Drainage of oil region, ... 605
Drake, Col., first oil well drilled by, ... 581
Drake, E. L., leases Penn Rock-oil Co's. property 597
" " preparations to drill oil well, ... 597
" well, ... 575, 582
Drilling for oil first suggested, ... 595, 597
Driller's key-rock in Butler co., ... 646
Dry holes drilled, ... 628

E.

Earl of Bellmont, report on oil springs, ... 576
Early discovery of oil, ... 575
Early method of collecting oil, ... 589
East Liverpool Gas Co.'s well No. 2, Columbiana county, Ohio, ... 784
Eaton, Rev. S. J. M., describes early method of collecting oil, ... 589
" " " history of the oil region of Venango co., ... 583
Economy well No. 2, specimens from, ... 653
Edenburg, Clarion county, sections at, ... 650
Edenburg, position of first oil sand at, ... 662
Eldred township, Warren co., character of oil from first oil sand in . . . 662
Elevations in oil region, ... 606
" of plateaus and summits, ... 611
Elk county, developments in, ... 604
" " well records in, ... 707

Page.
Elk oil group, ... 615
Elrod or Bayard well, Allegheny county, notes on, ... 667
Emery, E. G., farm, Emery's gas well, ... 758
Emery's gas well, Mt. Pleasant township, ... 758
Emery, L., authority for well record, ... 706
Emery and Miller's well, notes on, ... 680
Emery's well, location of, ... 680
“ “ record of, ... 706
Engines run by natural gas instead of steam, ... 600
Erie county, developments in, ... 603
Ethylene in natural gas, ... 790
Eudiometers used in gas analysis, ... 798
Eveleth, T. J., sale of first oil property, ... 595
Extension Oil Co., Jefferson center well, Welch farm, ... 716

F.

Failures to get gas in Potter co., ... 633
Farmington well, W. Va., ... 659
Fayette county, developments in, ... 604
“ “ well records in, ... 778
Ferriferous limestone and first oil sand, ... 662
“ “ the driller's key rock, ... 662
“Fifty foot rock,” 651
First drilled salt well, ... 588
“ flowing oil well, ... 598
“ oil lease, ... 595
“ oil sand, character of oil in Eldred twp., from, ... 662
“ “ “ depth at Pittsburgh, ... 661
“ “ “ “ “ Washington, ... 661
“ “ “ “ “ Waynesburg, ... 661
“ “ “ persistent from Tidioute to Waynesburg, ... 661
“ “ well in Washington co., ... 602
“ pipe line laid, ... 599
“ “ “ to seaboard, ... 601
“ “Wild Cat” well, ... 597
Fisher Oil Co., owners well No. 18, ... 711
“ “ “ “ “ No. 16, ... 712
“ “ “ well No. 18, record of, ... 651
Flat-iron, Rock city, ... 636
Flat pebble conglomerate, ... 640
Fluctuations in composition of natural gas, ... 827
Ford & Nelson's gas line, ... 602
“ “ “ “ notes of, ... 680
“ “ wells Nos. 1 & 2, notes on, ... 683
Forest county, developments in, ... 603
“ “ well records in, ... 700
“ “ districts, operations in 1886, ... 620
Fort Duquesne built, ... 578
“Fossil oil,” 581
Foster, Morrison, uses petroleum as a lubricator, ... 593

Page.
Free hydrogen in Speechley gas, ... 787 & 798
French creek, elevations on, ... 609
Fredonia, N. Y., natural gas first used at, ... 590
Fredonia gas, analysis of, ... 800
Franklin, celebrated lubricating oil of, ... 662
Frazer, John, early settler in oil region, ... 577
Fuel Gas Co.'s well No. 1, notes on, ... 674
Fuel value of natural gas, calculation of, ... 816
" " " " " table of, ... 825
Fundis farm, well on, ... 673
" well, notes on, ... 674
Funk's flowing oil well, ... 599
Future gas supply, ... 635

G.

"Ganos," Indian name for oil, ... 682
Gantz Mills, well at, ... 577
" sand, ... 651
" well, Citizens' Natural Gas Co., ... 762
" " first well in Washington co., ... 602
Garrard farm, Carpenter's well on, ... 774
Gas in south-western Venango, ... 614
" " Venango county, ... 613
Gas lines from Murrysville, ... 674
Gas piped from Murrysville to E. Liberty, ... 602
Gas pools, review of, ... 633
Gas pressure in Allegheny and Bradford weakened, ... 633
Gas rock, ... 651
"Gas sand" contains salt water at S. Pittsburgh, ... 652
Gas territory unexplored, ... 633
Gas used in place of steam, ... 634
Gas wells drilled near Pittsburgh, ... 601
Gayley, T. F., acknowledgment of assistance rendered by, ... 827
Geological horizon of Venango oil group, ... 616
" structure " " 612
Geography of oil regions, ... 605
Gibson & Giles, authority for Donaldson well record, ... 760
" " Scott well record, ... 759
" " Hervey gas well record, ... 761
" " Hess gas well No. 1 record, ... 760
" " Miller gas well record, ... 758
Gilfoyl station, P. & W. R. R., well near, ... 704
Gillespie and Armstrong, authority for Darlington well record, ... 780
" T. A., authority for well records, ... 668
" " & Burhton, wells located by, ... 671
Gilmore station, pipe lines at, ... 674
Glatzan well, record of, ... 699
Godfrey & Clark well, notes on, ... 684
Gordnier, W. B., farm, Guffey well on, ... 775

Page.
Gordon sand, not the lowest member of the oil group, . . . 657
" well No. 1, Gordon's farm, Washington county, . . . 765
" " record, . . . 656
Grace's well, record of, . . . 701
Graff, Bennett & Co., well, Carson street, Pittsburgh, record of, . . . 738
" " No. 1 well record, . . . 741
" " well No. 2, Sample farm, . . . 742
Grant and Horton, well record of, . . . 711
Grant, Mr., authority for well record, . . . 711
Grapeville gas field, . . . 684
Great Bend, position of First Oil sand at, . . . 662
" section at, . . . 641
Greene county, developments in, . . . 604
" well records in, . . . 772
Gretton, F. T., record kept by, . . . 653
" specimens from Jones & McLaughlin well No. 1, . . . 730
Guffey & Co., J. M., Westinghouse well No. 5, purchased from, . . . 669
" " well No. 1, Reel Bros. farm, . . . 744
Guffey well, W. B. Gardner's farm, Potter co., . . . 775
Guffey, Gailey and Co., wells drilled by, . . . 684

H.

Hair farm, well on, . . . 684
Hallock & Johnson well, record of, . . . 708
Halsey lands, Wilcox well No. 1 on, . . . 695
" No. 8, well record of, . . . 696
" No. 9, " . . . 698
Hammel, Mr., East Liverpool Gas Co.'s Well No. 1 record, . . . 784
Hamilton's well, notes on, . . . 671
Harper, Mr., Supt. Painter's Iron works, . . . 739
Hawey's farm, well on, . . . 673
Havens, Mr., obtains lease on Penn'a. Rock Oil Co.'s property, . . . 597
Hawkins, Dexter A., first oil well, . . . 596
Haymaker's, Lyons' run well No. 1, notes on, . . . 675
" well No. 1, struck, . . . 601
" " " notes on, . . . 673
Hays, General Samuel, purchases oil in 1803, . . . 590
Henry, W. C., acknowledgment of assistance rendered by, . . . 827
Hervey's Gas well, Hervey's farm, Canton twp., . . . 761
" well, notes on, . . . 681
Hess Gas well No. 1, Hess farm, Canton twp., . . . 760
Hess well, notes on, . . . 681
Hickory Gas field, Washington county, notes on, . . . 679
Highland township, Elk co., section in, . . . 645
Hildreth, Dr. L. P., describes early oil wells, . . . 588
History of oil developments, . . . 575
Homestead Steel works, pipe line to, . . . 676
Homewood sandstone described, . . . 647
Homewood sandstone in Pittsburgh section, . . . 654
" and vicinity, wells at, . . . 668
Hoodoo well, record of, . . . 702

Page.
Hoop W. farm, well on, ... 702
Horton, Walter, acknowledgment of assistance rendered by, ... 827
Hosmer run, first oil sand outcrops in valley of, ... 661
" " pits on, ... 582
Hostetter & Brown, wells No. 1 & 2, notes on, ... 673
Hough well, notes on, ... 681
Houlton well, notes on, ... 687
Houston well, analysis of gas from, ... 811
Howe twp., position of First Oil sand in, ... 662
" " Forest co., section at, ... 646
Hughes, S. B., authority for well record, ... 701, 702, 708, 713, 714
Hukill, E. M., authority E. M. Hukill & Co's. well No. 1, record, ... 782
" President, Carpenter's Nat. Gas. Co., ... 678
" Hukill well record, ... 752
" & Co's. well No. 1, Gallahue farm, ... 782
Hukill well, analysis of gas from, ... 807
Hukill's well, J. C. Bryant's farm, ... 752
" " No. 1, Dick's farm, ... 724
" " No. 2, Daum farm, ... 725
" " No. 3, Mr. McWilliams' farm, ... 725
" " Lentz farm, ... 725
" " yields Methane nearly pure, ... 687
"Hundred foot rock," 651
Hunter and Cummings, well No. 1, Jacob Reott farm, ... 718
Hunter run well, record of, ... 707
Hydrogen gas, description of, ... 787
Hydrogen in natural gas, determination of, ... 793

I.

Indiana county, developments in, ... 604
" " large gas well in, ... 604
" " well records in, ... 776
Indian ceremonies at oil springs, ... 597
" massacre at Fort Franklin, ... 578
" name for oil, ... 575
Inscription on leaden plates, ... 577
Irish brook, ... 637
Irvine, General W., describes Oil creek, ... 580
Irwin farm, well on, ... 674
" station well, Westmoreland county, ... 749
Ives, William A., lease of oil property, ... 596

J.

Jamestown, position of First Oil sand at, ... 662
" section at, ... 643
Jefferson Centre well, Welch farm, ... 716
" county, developments in, ... 604
" " well records in, ... 777
" Iron works, well record, ... 784
Jesuits find oil in 1642, ... 576

Page.
Johnsonburg well, record of, ... 710
Johnson and Gilmore well, record of, ... 708
Johnson, J., authority for well record, ... 707,708
Johnson, Sir William, describes oil in 1767, ... 579
Johnson, Wm. Bissell, well record, ... 751
Johnson, Wm. Vandergrift or Erchman, well record, ... 751
" " Weston, well record, ... 751
Johnstown, supplied with gas from Grapeville, ... 635
Jones & Laughlin, well No. 2, record of, ... 733
" " well No. 1, Am. Iron & Steel works, ... 730
" " well No. 2, record of, ... 658

K.

Kane district, operations in 1886, ... 620
Kane gas, analysis of, ... 804
Kane well No. 1, analysis of gas from, ... 804
Kaney, Wm., authority for well record, ... 710
Keeler, Mr. Anthony, authority for well record, ... 703
Kennedy, John Q., farm, Associated Producers' well No. 12, ... 715
Kersetter, T. J., authority for well record, ... 700
Keystone well, notes on, ... 665
Kier, Mr., refines petroleum, ... 594
Kier's petroleum used as a medicine, ... 594
King No. 1 well, notes on, ... 674
Kinzua creek, elevations on, ... 608
Kiskiminetas river, elevations on, ... 608

L.

Lake Erie divide, ... 606
Lanahan, J. K., record St. James well, W. Va., ... 781
Landsrath, H., authority for well record, ... 703
Laundry well, notes on, ... 671
Lawrence county, developments in, ... 603
Leisberger, David, missionary, describes oil springs, ... 578
Leiber farm, Philip's well No. 1, ... 715
Lentz farm, Hukill well, on, ... 725
" well, notes on, ... 678
Leslie farm, well on, ... 684
Lincoln, Gen'l Benjamin, reports oil on Oil Creek in 1783, ... 579
Linton, Prof., record of Thayer's well by, ... 656,764
Liquifaction of Methane, ... 791
List of books, papers and references on oil and gas, ... 828
Loskell, Geo. H., writes of oil in 1789, ... 580
Lyon's run field, number of wells in, ... 679
" " notes on, ... 675
" " notes on wells S. W. of, ... 678
" pool, National Tube Co.'s well in, ... 678
" well, pipe line from, ... 674

Page.

M.

Mahoning sandstone, oil bearing on Dunkard creek, . . . 613
Maloney or Pottery well, notes on, . . . 672
Mansfield junction, size of pipe line at, . . . 680
Marienville, Forest county, section at, . . . 646
" position of First Oil sand at, . . . 662
Marr, W. C., contractor, Gantz well, . . . 762
Marshall farm, record of well No. 16, . . . 712
" well on, . . . 711
Martin, Thomas, Carpenters Nat. Gas Co.'s well No. 1, . . . 726
McCalmont Oil Co., owners Dillworth well, . . . 670
McCandless, Sarah, farm, gas well on, . . . 714
" " record of well No. 1, . . . 715
McGrew, D., authority Millinger's well No. 1, . . . 717
McGuigan's gas well No. 1, Washington county, . . . 754
" " struck, . . . 601
" well No. 1, location of, . . . 679
" " No. 2, " . . . 680
McJunkin & Co.'s well No. 1, Dean farm, . . . 718
McKean county, developments in, . . . 603
" " well records in, . . . 695
" district, operations in 1886, . . . 619
" oils from older rocks than Venango oil group, . . . 662
" oil group, . . . 614
McKee salt well on Duck creek, . . . 588
McKay, Loyd & Co. mills, gas supplied to, . . . 679
McMullen, J. C., authority for well record, . . . 702
McNair, John, acknowledgment of assistance rendered by, . . . 827
McWilliams farm, Hukill Well No. 3, . . . 725
McWilliams farm well, notes on, . . . 678
Meadville, section at, . . . 643
Meanor farm, well on, . . . 673
Means farm, well on, . . . 685
Mecca, Ohio, pits at, . . . 582
Mehaffey, J. A., Beaver Valley well, . . . 727
Mercer county, developments in, . . . 603
Mercer twp., Butler county, position of First Oil sand in, . . . 662
" " section in, . . . 649
Methane, description of, . . . 788
" illuminating powers of, . . . 789
" nearly pure in Hukill well, . . . 789
" the principal constituent of natural gas, . . . 791
Method of analysis of natural gas, . . . 793
" collecting samples of natural gas, . . . 792
Miller's Forge, pipe line to, . . . 676
Miller gas well, Miller's farm, . . . 758
Miller well, location of, . . . 680
Millinger farm, well No. 1, record of, . . . 717
Montcalm, Gen., report on oil made to, . . . 577
Mooney, Mr., authority for well record, . . . 704

Page.

Morehead & Co., record Morehead & Co.'s well, 736
Morck & Dimick well, record of, 698
Morehead & Co. well, gas from horizon of Cannon's well, 666
Morrow, J., farm, well on, 676
Morton, Howard, farm, well on, 666
Morton well, Pittsburgh, notes on, 666
"Mountain sand," 641
" " Shenango S. S. ?, 648
Mount Pleasant twp., section in, 657
" " position of First Oil sand in, 662
Miller farm, first pipe line on, 599
Munhall & Smithman well, Sherrick farm, 748
" " " Snodgrass farm, 746
" Wm., Munhall well record, 752
" well, Murrysville sand in, 660
" " Wallace station, Allegheny county, 752
Murphy, M., authority for well record, 708
Murphy well, record of, 708
Murrysville belt, companies operating on the, 694
" " description of, 694
" field, considerable gas being wasted in, 675
" " number of wells in, 679
" gas, analysis of, 807
" gas field, 634
" " " notes on, 673
" " lines from, 674
" position of First Oil sand at, 662
" section at, 660
Murry well No. 2, Phil. Nat. Gas Co. of Pittsburgh, 722

N.

Natural Transit Co., well owned by, 696
Natural gas, collections of samples for analysis, 792
Natural gas, first used for lighting houses, 590
" " " " in iron making, 600
" " introduced in Pittsburgh in 1883, 664
" " used for running engines, 600
National Tube Co. of McKeesport, notes on well of, 678
" " works, well No. 1, notes on, 676
Newton's Gas well, 600
New wells drilled, production, &c., in 1886, 629
Niagara Oil Co., Buchanan well, 755
" " " MrcGuigan's Gas well No. 1, 754
" " " sold McGuigan's well in 1882. 680
" " " notes of wells of, 679
Nitrogen, determination of, in natural gas, 794
Nitrogen in natural gas, 790
Noel farm, record well No. 3, 713
North Baltimore well, Wood Co., Ohio, 786
Notes relating to natural gas wells and pipe lines, 664

Page.

O.

Oil and gas always found in sandstones in Penna., ... 613
Oil Creek, elevations on, ... 609
" Valley, traces of early oil operations, ... 584
Oil and gas developments in 1886, ... 618
Oil on Cumberland river, ... 589
Oil Shipped to Pittsburgh, ... 590
Oil used as a horse medicine, ... 590
Old Glass House well, Greene Co., ... 774
Old Tarentum, Graff, Bennett & Co. well, notes on, ... 682
Oleau Rock City, ... 636
Olefiant gas, ... 790
Olefines in natural gas, determination of, ... 790, 796
Outlines of producing areas defined, ... 628
Oxygen in natural gas, determination of, ... 791, 795

P.

Page plate showing position of columnar sections, ... 638
Painter's farm, well on, ... 686
Painter, J. & Sons, record of Painter well, ... 739
Painter & Sons iron mills, obtain gas from McGuigan's well, ... 602
" " Iron works, gas used by, ... 680
Painter's well, notes on, ... 688
" " J. Painter & Sons, record of, ... 739
Paraffins in natural gas, determinations of, ... 796
" of Fredonia gas, composition of, ... 821
" " Murrysville gas, composition of, ... 821
Parke Bros. & Co's. well, record authority for, ... 741
" " " well, Pittsburgh, Pa., ... 741
Parkinson's well, West Va. Nat. Gas Co., ... 769
Parnassus well, on Geo. Thompson's farm, ... 727
Peckham, Prof., report on petroleum, ... 582
Pennsylvania Gas Co., acknowledgement of assistance rendered by, . . 827
Pennsylvania R. R. Co. well record, Wall Station, ... 749
" Rock Oil Co. organized, ... 595
" Salt Mfg. Co.'s wells, 1, 2 and 3, notes on, ... 682
Peterson, Lewis, obtains oil from salt well, ... 593
Petrolia, Butler Co., section at, ... 649
" position of First Oil sand at, ... 662
Petroleum in salt wells, ... 588
" list of books and papers on, ... 828
Pew & Emerson's gas line, ... 602
" " well No. 1, notes on, ... 673
" " " Nos. 1, 2 and 3, notes on, ... 670
Philadelphia Co., composition of, ... 693
" Gas Co., acknowledgement of assistance rendered by, ... 827
Phillips' well No. 1, Leiber farm, ... 715
Philadephia Natural Gas Co., Pittsburgh, Murry well No. 2, ... 722
" " " " Wilkin well No. 1, ... 722

Page.
Philadelphia Westinghouse Gas Co. wells, notes on, ... 672
" " " wells, notes on, ... 674
" " " " 1 and 3, notes on, ... 684, 685
Pierpont, Asahel, lease of oil property, by, ... 596
Pike's rocks, ... 637
Pittsburgh Bessemer Steel Co.'s well, ... 744
" list of companies piping gas into, ... 692
" position of First Oil sand at, ... 662
Pittsfield township, pits in, ... 582
Pithole, pits at, ... 582
Pits, supposed to have been dug for oil, ... 582
Pleasantville oil region developed, ... 600
Plumley farm, well on, ... 686
Pocono formation described, ... 640
Pocono sandstone produces oil and gas, ... 613
Potter Co., developments in, ... 603
" well records in, ... 775
Pottery or Maloney wells, notes on, ... 672
Pottsville conglomerate sometimes produces oil and gas, ... 613
Pressure prevents deeper drilling at Murrysville, ... 660
Principal oil and gas group of the region, ... 614
Production not sufficient to meet demands, ... 628
Prospecting for oil first commenced, ... 596
Prospective estimate of production of new wells, ... 626
Public lighting of Pittsburgh with oil, ... 590
Pugh's farm well, Butler Co., ... 714
Purdy, T. C., authority for Salem gas well record, ... 785

R.

Raccoon creek gas, analysis of, ... 809
Ratio of available to calculated heat of combustion of hydro-carbons, . . 818
Red Bank Creek, elevations on, ... 608
Red clay sands, generally barren of oil and gas, ... 659
Red House run, ... 637
Red rocks no guide to identification of groups, ... 639
Red Valley pool discovered, ... 602
Reed farm well, Associated Producer's Co., Wash. Co., ... 766
Reed, Franklin, trustee of first Oil company, ... 596
Reed Bros. farm, J. M. Guffey's well No. 1, ... 744
Reiber, Mr., authority for gas well record, Butler Co., ... 714
Remaley, A., farm, well on, ... 673
" Henry, farm, Boulton & Doubleday No. 1 well, record of, . . . 721
Reno well No. 1, record of, ... 700
Reott, Jacob, farm, Hunter & Cummings well No. 1, ... 718
Relative importance of the several oil and gas groups, ... 615
Review of gas pools, ... 633
Richard and Hartley well, notes on, ... 682
Risher farm, well on, ... 666
Rivers farm, well No. 1, record of, ... 716
Robbins, C. D., Rush farm record, ... 756

Page.
Rochester supplied with gas from Beaver field, ... 635
Romer, Wolfgang W., instructed to visit oil springs, ... 576
Roy and Archer's well No. 3, record of, ... 707
Rush well, location of, ... 679
" Rush farm, ... 756

S.

Salem gas well, Columbiana, Ohio, ... 785
Salisbury, Jas. H., trustee of First Oil company, ... 596
Sample farm, Gerties run, Graff, Bennetts & Co.'s well No. 2, ... 742
Salt water sand, ... 651
" " wells in Allegheny Co., sunk in, ... 665
" wells in Kentucky and Tenn., ... 588
Say well No. 5, Wildwood Oil Co., ... 749
Schoff, Dr. T. D., writes of oil on the Allegheny river, ... 580
Scott, Jos., first gazetteer of U. S. published by, ... 581
" well, location of, ... 680
" " J. S. Scott farm, Cecil twp., ... 759
Section at Bradford, ... 640
" Bullion run, ... 647
" Church run, Crawford Co., ... 642
" Coudersport, ... 644
" Edenburg, Clarion Co., ... 650
" Great Bend, Warren Co., ... 641
" Jamestown, Mercer Co., ... 643
" Marienville, Forest Co., ... 646
" Meadville, ... 643
" Murrysville, ... 660
" Petrolia, Butler Co., ... 649
" Pittsburgh, ... 652
" Thorn Creek, Butler Co., ... 650
" Tidioute, ... 642
" Waynesburg, ... 658
" Warren, ... 642
" Washington, ... 656
Section in Allegany Co., N. Y., ... 639
" Highland twp., Elk Co., ... 645
" Home twp., Forest Co., ... 646
" Mercer twp., Butler Co., ... 649
" Mount Pleasant twp., ... 657
" Sergeant twp., McKean Co., ... 645
Selection of gas samples for analysis, ... 799
Seneca oil, ... 581
" Co. formed, ... 597
Sergeant twp., McKean Co., section in, ... 645
Settlement of the oil country, ... 582
Shannopin district, operations in 1886, ... 622
Sharpsburg, gas piped to, ... 600
Sharon conglomerate, absent in Economy well No. 2, ... 637
Sharon-Olean Conglomerate, ... 636

Page.
Sharon S. S. absent at Washington, 658
Stratigraphical review of Venango oil group, 636
Sheffield gas, analysis of, 802
Sheffield Gas Co.'s wells 1, 2 and 3, analysis of gas from, 802
Sheffield gas field, 633
Sheldon, Anson, trustee of First Oil company, 596
Shenango Sandstone, Sub-Olean, 640
Sherrich farm, Munhall & Smithman well, 748
Silliman, Prof. B., report on Cuba oil spring, 591
" " oil, 596
"Singular rocks," 637
Six Mile Ferry well, Allegheny Co., notes on, 666
Smith farm, well on, 683–685
Smith, John, well, sections of, 648
Snodgrass farm, Munhall & Smithman well, 746
Snyder's farm, Boice well record, 776
Soles, J. B., farm, Black well record, 750
Souilliere well, Allegheny Co., notes on, 666
" Antoine, farm, well on, 666
Southern field, future of, 663
Spang & Chalfant well, notes on, 687
Speechley gas, analysis of, 805
Speechley gas contains free hydrogen, 798
" gas sand, 638
" " location of, 663
" pool, gas allowed to waste, 633
" sand contains water in places, 634
Spencer wells, No. 1 and 2, notes on, 671
Spouting wells struck, 599
Spring Creek twp., pits in, 582
Springdale well, notes on, 687
Stein farm, well on, 689
Stewart farm, well on, 673
Stewart & Irwin tract, well on, 705
St. James well, Ohio Co., West Va., 781
Stockton, Lemuel, strikes oil while boring for salt, 589
Stone and Clark well No. 3, 713
Stoneham, first well at, 601
Structure immediately below Sharon, Olean conglomerate, 639
Structure of the oil rocks, 612
Sub-Olean, a flat pebble cong. in the East, 640
" conglomerate, 640
Sulphuretted hydrogen in Raccoon creek gas, 814
Summary of oil production to 1886, 602
Sutton's well, No. 4, 651

T.

Table of gas analysis, 815
" fuel values of natural gas, 825
" wells drilled in 1886, 623
" new wells drilled, production, &c., in 1886, 629

Page.
Taylor, O. P., authority for Triangle well No. 1, record, 774
Tarentum gas field, 634
" Heat & Light Co.'s well, notes on, 684
" Gas lines, list of companies, 693
" " wells, notes on, 682
" supplied with gas from Murrysville, 634
Tarkill pool, 634
Taylor's salt works, gas used by, 680
Teamsters threaten to destroy pipe lines, 599
Test for ammonia in gas from Murrysville field, 808
Thayers, D. J., well record by, 701
" well, Farley farm, Washington Co., 764
Thermometer used in gas analysis, 797
Thompson's, Fuel Gas Cos.' station at, 674
Thompson, Edgar, Steel works, Braddock gas piped to, 675
" Geo., farm, Parnassus well on, 727
" Phin. Old Glass House well record, 774
Thomsen, Julius, researches in thermochemistry, 819
Thomson farm, record well No. 1, 718
Thorn Creek, Butler Co., 650
" " district, well record in, 712
" " position of first Oil Sand at, 662
Tide water pipe line, 601
Tidioute, position of first Oil Sand at, 662
Tidioute, section at, 642
Tin plate well, Allegheny Co., notes on, 667
Tionesta creek, elevations on, 608
Titus, Jonathan, settles at Titusville, 1797 581
Titusville obtains gas for light and fuel from Newton well, 600
" pits at, 582
Tomlinson, J. A., authority for well record, 700
Topography of oil region, 605
Transition rocks of Pocono and Chemung, 643
Trego, Charles B., describes early oil industry, 592
Trenches dug to collect oil, 596
Triangle well, Washington Co., 767
" " No. 1, Crandall farm, Allegany Co., N. Y., 774
Tunangwant Creek, elevations on, 608
Twin line, Fuel Gas Co., 674
Typical section at Bullion run, 647

U.

"Uncle Billy Smith," drills Drake well, 598
Undiscovered pools, 628

V.

Vandergrift or Erchman well, Shaw's farm, 751
" T. J., authority for well record, 688
" " " Vandergrift's well, No. 1, record, 786

Page.

Vandergrift, T. J., authority Vandergrift well, record, ... 779
" " specimens from Parkinson's well, ... 653
" Parkinson's well, record by 769
" well, Independence twp., Beaver Co., ... 779
" " No. 1, Frank's farm, Wood Co., Ohio, ... 786
" " " Weirich farm, Washington Co., Pa., ... 767
" " " notes on, ... 688
" " " record of, ... 700
Vensel well, record of, ... 700
Venango county, developments in, ... 603
" district, operations in 1886, ... 621
" First oil sand, table of dips of, ... 661
" group, a transition series, ... 616
" oil group, ... 613
" " and Ferriferous limestone, relative positions of, . . . 662
" " locations of productive portion of, ... 662
" " Southern field dependent upon the scope of the, . . 663
" " well developed, ... 651
Verner, No. 1 well, notes on, ... 674

W.

Wallace farm, record of well No. 19, ... 712
Wall, J. S., authority for Bellevernon Gas well No. 1, record, ... 778
" Station well, Penn'a. R. R., ... 749
Walters' farm, well on, ... 701
Warren Co., developments in, ... 603
" well record in, ... 698
" district, operations in 1886, ... 620
" oils from older rocks than Venango oil group, ... 663
" oil group, ... 614
" position of first Oil Sand at, ... 662
" section at, ... 642
Washington's expedition to Wenango, Pa., ... 578
Washington borough, list of companies in, ... 693
" character of oil from first sand at, ... 662
" county, developments in, ... 604
" " list of wells in, ... 691
" " well records in, ... 754
" district, operations in 1886, ... 622
" gas field, ... 634
" Light & Heat Co., notes of wells of, ... 681
" " owners of Gorden well No, 1, ... 765
" Oil Belt resembles the Venango-Butler Belt, ... 657
" position of first Oil Sand at, ... 662
" section at, ... 656
Waste of gas in Murrysville field, ... 675
" " the Speechley pool, ... 633
Waynesburg Gas Co. well No. 1, Greene Co., ... 772
" position of first Oil Sand at, ... 662
" section at, ... 658

Page.
Wehrle farm, well on, ... 683
Welch farm, Jefferson Center well, ... 716
Wells in Allegheny Co., list of, ... 690
" " Beaver Co., list of, ... 692
" drilled in 1886, table showing, ... 623
" in Washington Co., list of, ... 691
" in Westmoreland Co., list of, ... 691
Well No. 18, Marshall farm, record of, ... 711
"Wenango," (Franklin,) 377
Westinghouse well No. 1, ... 602
" " Nos. 1 and 2, notes of, ... 668
" " " 3 to 7, notes on, ... 669
Westmoreland Co., developments in, ... 604
" " list of wells in, ... 691
" " well records in, ... 721
Weston well on Pauline Auburle farm, ... 751
Well records in Allegany Co., N. Y. 774
" Allegheny county, Pa., ... 730
" Beaver county, Pa., ... 779
" Butler county, Pa., ... 711
" Columbina county, Ohio, ... 784
" Elk county, Pa., ... 707
" Fayette county, Pa., ... 778
" Forest county, Pa., ... 700,702,703
" Greene county, Pa., ... 772
" Indiana county, Pa., ... 776
" Jefferson county, Pa., ... 777
" Potter county, Pa., ... 775
" Warren county, Pa., ... 698,702
" Washington county, Pa., ... 754
" Westmoreland county, Pa., ... 721
" West Virginia, ... 781
Well record Associated Producers' well No. 12, ... 715
" Balph's well, ... 713
" Barclay's well, ... 783
" Beatty's farm, well No. 2, ... 719
" Beaver Valley well, ... 727
" Belle Vernon gas well No. 1, ... 778
" Best well No. 1, ... 702
" Bingham's farm, well No. 3, ... 719
" Bissel's well, ... 751
" Black's well, ... 750
" " farm, well No. 4, ... 720
" Boice well, ... 776
" Boughton's well, ... 709
" Boulton and Doubleday's well No. 1, ... 721
" Boulton and Doubleday's well No. 1, on Lyon's run, ... 724
" Butler Gas Co.'s well No. 1, ... 715
" Bovard well, ... 720
" Brookville well No. 2, ... 777
" Buchanan's well 755

Page.
Well record Carlisle's well, ... 760
" Canonsburg well, ... 762
" Carpenter's well, ... 774
" Carpenter Natural Gas Co.'s well No. 1, ... 726
" Cornwall's well No. 3, ... 703
" Craig's well No. 1, ... 716
" Crane Run well, ... 709
" Crull, Campbell & Co.'s well, ... 704
" Darlington's well, ... 780
" Donaldson's well, ... 760
" East Liverpool Gas Co.'s well No. 2, ... 784
" Emery's well, ... 758
" Emery's well, ... 708
" Gantz's well, ... 762
" Glatzan's well, ... 699
" Gordon's well No. 1, ... 765
" Grace's well, ... 701
" Graff, Bennett & Co.'s well, ... 738
" " " " No. 1, ... 741
" " " " No. 2, ... 742
" Grant and Horton's well, ... 711
" Guffey's well, ... 775
" Guffey, J. M. & Co.'s well No. 1, ... 744
" Hallock and Johnson's well, ... 708
" Harvey's well, ... 761
" Hess well No. 1, ... 760
" Hoodoo well, ... 702
" Hukill's well, ... 752–725
" " No. 1, ... 724
" " No. 2, ... 725
" " No. 3, ... 725
" Hukill, E. M. & Co.'s well No. 1, ... 782
" Hunter and Cumming's well No. 1, ... 718
" Hunter Run well, ... 707
" Irwin Station well, ... 749
" Jefferson Center well, ... 716
" " Iron Works well, ... 784
" Johnsonburg's well, ... 710
" Johnson and Gilmore's well, ... 708
" Jones and Laughlin's well No. 1, ... 730
" " " No. 2, ... 733
" Marshall's farm, Well No. 16, ... 712
" " " No. 18, ... 711
" Miller's well, ... 758
" Millinger's well, ... 717
" Morck and Dimick's well, ... 698
" Morehead and Co.'s well, ... 736
" McGuigan's well No. 1, ... 754
" McJunkin and Co.'s well No. 1, ... 718
" Munhall's well, ... 752
" Munhall and Smithman's well, ... 746,748

Page.

Well record Murphy's well, ... 703
" Murry's well, ... 722
" National Transit Co.'s well, No. 8, ... 696
" " " " " No. 9, ... 698
" Noel's well, No. 3, ... 713
" North Baltimore well, ... 786
" Old Glass House well, ... 774
" Painter's well, ... 739
" Parke Bro. and Co.'s well, ... 741
" Parkinson's well, ... 769
" Parnassus well, ... 727
" Pittsburgh Bessemer Steel Co.'s well, ... 744
" Phillip's well No. 1, ... 715
" Pugh's well, ... 714
" Reed's farm well, ... 766
" Reiber's well, ... 714
" Reno's well, No. 1, ... 700
" Roy and Archer's well, No. 3, ... 707
" Rush's well, ... 756
" Salem well, ... 785
" Say well No. 5, ... 749
" Scott's well, ... 759
" St. James' well, ... 781
" Thayer's well, ... 764
" Thompson's farm, well No. 1, ... 718
" Triangle well, ... 767
" Triangle well No. 1, ... 774
" Vandergrift's well, ... 700, 779
" " well No. 1, ... 767, 786
" " or Erchman's well, ... 751
" Vensel's well, ... 700
" Wall Station well, ... 749
" Wallace farm, well No. 19, ... 712
" Waynesburg Gas Co.'s well No. 1, ... 772
" Weston's well, ... 751
" Whitney's well, ... 705
" Wilkin's well No. 1, ... 722
" Wilcox and Co.'s. well No. 1, ... 695
" Windfall's well No. 1, ... 704
Wheeling supplied with gas from Washington field, ... 635
White, I. C., measurements in Mercer and Beaver Co., ... 647
" thickness of Shenango S. S. in Mercer, ... 649
White lime, mountain limestone, ... 659
Whitney's well, record of, ... 705
Wilcox gas, analysis of, ... 803
Wilcox gas pool, ... 633
Wilcox & Co. well No. 1, record of, ... 695
Wilcox well No. 7, analysis of gas from, ... 803
Wildwood Oil Co., owners of Asa Say well, ... 671
" " Say well No. 5, authority, driller's book, ... 749
Windfall well No. 1, record of, ... 704

Page.
Wilkin well No. 1, Phila. Nat. Gas Co., Pittsburgh, ... 722
Willard, Rev. Jos., letter about oil to, ... 579
Wilson well, notes on, ... 685
Wilson, A. P., authority for well record, ... 685
Wolf, A. W., authority Vandergrift's well record, ... 767
Wood and Co., W. D., rolling mills of, ... 679
Wood well, notes of, ... 668
Wray, D. A., specimens of Wilcox well presented by, ... 695
West Va. Nat. Gas Co., Parkinson's well, ... 769
" well records in, ... 781

Y.

Youghiogheny Natural Gas Co., Weston's well, ... 751
" river elevations on, ... 608
Youngstown supplied with gas from Beaver field, ... 635

Z.

Zimmerly, Henry, farm, well on, ... 688
" J., farm, well on, ... 688
Zimmerman's well, notes on, ... 672

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9. Mehoopany Coal Field. F. A. Hill.
10. Cornwall Ore Mines. J. P. Lesley and E. V. d'Invilliers.
11. Delaware and Chester Kaolins. J. P. Lesley and C. A. Ashburner.
12. Quaternary Geology, Wyoming Valley. C. A. Ashburner, F. A Hill, and H. C. Lewis.
13. Pressure, &c., of Rock Gas. J. P. Lesley.
14. Progress Geodetic Survey. Mansfield Merriman.

1886 ANNUAL. J, P. Lesley, State Geologist, 8°, in four parts, as follows:

- i. Pittsburgh Coal Region.
- ii. Oil and Gas Region.
- iii. Anthracite Coal Region with Atlas.
- iv. Miscellaneous Reports on Special Subjects.

IN PRESS.

MISCELLANEOUS REPORTS.

A. A history of the FIRST GEOLOGICAL SURVEY of Pennsylvania, from 1836 to 1858, by J. P. Lesley. With the annual reports of the Board to the Legislature for 1874 and 1875. 8°, pp. 226, 1876.

B. Report on the MINERALS of Pennsylvania, by F. A. Genth; and on the hydro-carbon compounds, by S. P. Sadtler. With a reference map of the State. 8°, pp. 206, 1875.

B 2. Report on the MINERALS, by F. A. Genth, continued from page 207 to 238. 8°, in paper cover, pp. 31, 1876. (Bound with B.)

M. Report of CHEMICAL ANALYSES in 1874–5, in the Laboratory at Harrisburg, by A. S. McCreath. 8°, pp. 105, 1875.

M 2. Report of CHEMICAL ANALYSES in 1876–8, by A. S. McCreath; Classification of coals, by P. Frazer; Fire-brick tests, by F. Platt; Dolomitic limestone beds, by J. P. Lesley; Utilization of anthracite slack, by F. Platt; Determination of Carbon in iron or steel, by A. S. McCreath. With one folded plate (section at Harrisburg) and four page plates. 8°, pp. 438, 1879.

M 3. Report of CHEMICAL ANALYSES in 1879–80, by A. S. McCreath. With a reference map of 93 iron ore mines in the Cumberland Valley. 8°, pp. 126, 1881.

N. Report on the LEVELS above tide of railroads, canal, and turnpike stations, mountain tops, &c., in and around Pennsylvania, in 200 tables, by C. Allen. With a map. 8°, pp. 279, 1878.

O. CATALOGUE of specimens collected by the survey, (No. 1 to No. 4,264,) by C. E. Hall. 8°, pp. 217, 1878.

O 2, CATALOGUE (continued from No. 4,265 to No. 8,974); also catalogue of fossils, (pp. 231 to 239.) 8°, pp. 272, 1880.

P. Report on the COAL FLORA of Pennsylvania and the United States, Vols. 1 and 2, (bound together,) by L. Lesquereux. 8°, pp. 694, 1880.

P. Report on the COAL FLORA of Pennsylvania and the United States, Vol. 3, with 24 double page plates (lithographed) of coal plants, to accompany P., Vols. 1 and 2. 8°, pp. 283, 1884.

(P.) ATLAS of 87 double page plates (lithographed) of coal plants, to accompany P., Vols. 1 and 2. 8°, 1879.

P 2. Report on Permo-Carboniferous plants from W. Va. and Greene county, Pennsylvania, by W. M. Fontaine and I. C. White. With 38 double page plates (lithographed). 8°, pp. 143, 1880.

P 3. Description of *Ceratiocaridæ*, by C. E. Beecher; and of *Eurypteridæ*, by James Hall. With 8 plates. 8°, pp. 39, 1884.

Z. Report on the TERMINAL MORAINE across Pennsylvania, by H. C. Lewis; including extracts from descriptions of the Moraine in New Jersey, by G. H. Cook, and in Ohio, Kentucky, and Indiana, by G. F. Wright. With a map of the State, 18 photographic views of the Moraine, and 32 page plate maps and sections. 8°, pp. lvi and 299, 1884.

GRAND ATLAS, Div. I, Pt. I, 1885, port-folio containing maps of 56 counties and parts of counties (scale 2 miles to 1 inch) on 49 sheets (26"×32".) These maps are duplicate prints on heavy paper of the county maps contained in the reports of progress.

Annual Report, 1886. Part IV.

ANTHRACITE REGION.

A 2. Report on the causes, kinds, and amount of WASTE in mining anthracite, by F. Platt; with a chapter on METHODS of mining, by J. P. Wetherill.

Illustrated by 35 figures of mining operations, a plan of the Hammond breaker, and a specimen sheet of the maps of the Anthracite coal fields. 8°, pp. 134, 1881.

AC. Report on MINING METHODS, &c., in the anthracite coal fields, by H. M. Chance. Illustrated with 54 plates and 60 illustrations in the text. 8°, pp. 574, 1883.

(AC.) ATLAS containing 25 plates illustrating coal mining, to accompany Report AC, by H. M. Chance. 8°, 1883.

AA. First report of progress of the anthracite survey; PANTHER CREEK BASIN, by C. A. Ashburner; with a determination of the latitude and longitude of Wilkes-Barre and Pottsville, by C. L. Doolittle; and a theory of stadia measurements, by A. Winslow. 8°, pp. 407, 1883.

AA. Second report of progress of the anthracite survey, Part I; Statistics of Production and Shipment for 1883 and 1884. Charles A. Ashburner, geologist in charge.

(AA.) ATLAS OF SOUTHERN anthracite field, Part I, containing 13 sheets; 3 geological and mine sheets, 3 cross section sheets, 3 columnar section sheets, 1 topographical map sheet, and 1 coal bed area sheet, relating to the PANTHER CREEK BASIN; 1 general map of the anthracite region, and 1 chart of anthracite production from 1820 to 1881. 8°, 1882. Charles A. Ashburner, geologist in charge; A. W. Sheafer and Frank A. Hill, assistant geologists.

(AA.) ATLAS OF WESTERN MIDDLE anthracite field, Part I, containing 11 sheets: 4 geological and mine sheets between Delano and Locust Dale, 3 topographical sheets between Quakake Junction and Mount Carmel, and 4 cross section sheets. 8°, 1884. Charles A. Ashburner, geologist in charge; A. W. Sheafer and Bard Wells, assistant geologists.

(AA.) ATLAS OF NORTHERN anthracite field, Part I, containing 6 geological and mine sheets between Wilkes-Barre and Nanticoke, 3 cross section sheets, and 4 columnar section sheets. 8°, 1885. Charles A. Ashburner, geologist in charge; Frank A. Hill, assistant geologist.

(AA.) ATLAS EASTERN MIDDLE anthracite field, Part I, containing 8 sheets—2 geological and mine sheets in the vicinity of Hazleton, Drifton, and surrounding towns, 3 cross section sheets, and 3 columnar section sheets. 8°, 1885. Charles A. Ashburner, geologist in charge; A. P. Berlin and Arthur Winslow, assistant geologists.

GRAND ATLAS, Div. II, Pt. I, 1884. Port-folio containing 26 sheets, (26″ × 32″,) as follows: 13 sheets Atlas Southern Anthracite Field, Part I, 11 sheets Atlas Western Middle Anthracite Field, Part I, 1 sheet photo views of plaster models in Western, Middle, and Southern Fields, and 1 specimen sheet, Report A 2.

GRAND ATLAS, Div. II, Pt. II, 1885. Port-folio containing 22 sheets, (26″ × 32″,) as follows: 13 sheets Atlas Northern Anthracite Field, Part I, 8 sheets Atlas Eastern Middle Anthracite Field, Part I, and 1 sheet containing a preliminary general map of the Anthracite Coal Fields and adjoining counties.

For anthracite coal in SULLIVAN county, see G 2, and Annual Report, 1885.

For Conglomerate beds near Carbondale, Pittston, &c., see G 5, G 7.

For Utilization of anthracite slack, see M 2.

For General description anthracite region, Quaternary Geology of the Wyoming-Lackawanna Valley, &c., &c., see Annual Report, 1885.

Annual Report, 1886. Part III.

BITUMINOUS COAL FIELDS AND SURROUNDING AREAS.

H. First report on CLEARFIELD and JEFFERSON counties, by F. Platt. With 8 maps, 2 sections, and 139 cuts in the text. 8°, pp. 296, 1875. (*For second report, see H 6, H 7.*)

H 2. Report on CAMBRIA county, by F. & W. G. Platt. With 4 maps and sections and 84 cuts in the text. 8°, pp. 194, 1877.

H 3. Report on SOMERSET county, by F. & W. G. Platt. With 6 maps and sections and 110 cuts in the text. 8°, pp. 348, 1877.

H 4. Report on INDIANA county, by W. G. Platt. With a colored geological county map and 87 cuts in the text. 8°, pp. 316, 1878.

H 5. Report on ARMSTRONG county, by W. G. Platt. With a colored geological county map and 58 cuts in the text. 8°, pp. 338, 1880.

H 6. Second report on JEFFERSON county, (*See H above,*) by W. G. Platt. With a colored geological county map and 57 cuts in the text. 8°, pp. 218, 1881.

H 7. Second report on CLEARFIELD county, (*See H above,*) by H. M. Chance. With a colored geological county map, an outcrop map of the Houtzdale basin and 58 cuts in the text. 8°, pp. 197, 1884.

I. Report on VENANGO county, by J. F. Carll. The geology around Warren, by F. A. Randall. Notes on the comparative geology of N. E. Ohio, N. W. Pa., and W. New York, by J. P. Lesley. With one small map of the Venango oil region, one small map of the region south and east of Lake Erie, one long section of the rocks at Warren, and 7 cuts in the text. 8°, pp. 127, 1875.

I 2. Report of oil well records and levels in VENANGO, WARREN, CRAWFORD, CLARION, ARMSTRONG, BUTLER, &c., by J. F. CARLL. 8°, pp. 398, 1877.

I 3. Report on the VENANGO, WARREN, CLARION, and BUTLER OIL REGIONS; descriptions of rig, tools, &c.; survey of the Garland and Panama conglomerates, &c; discussion of pre-glacial and post-glacial drainage, by J. F. Carll. With 23 page plates and an atlas. 8°, pp. 482, 1880.

(I 3.) Atlas of 22 sheets. Map of Venango county, colored geologically; map of lower oil field (Butler, Armstrong, and Clarion) in two sheets; 3 local contour maps at Franklin, Titusville, and Spring Creek; two maps of N. W. Pennsylvania, showing the past and present drainage; long section across W. Pennsylvania; vertical section of the formations from the Upper Coal measures down to the bottom of the Devonian; diagram map and section of Third sand; profile section from Meadville, S. W.; 5 sheets of grouped oil well sections; 5 sheets of working drawings for well boring, &c.; diagram of daily rate of drilling six wells at Petrolia.

I 4. Report on WARREN county, by J. F. Carll. With a colored geological county map, a map of the Warren oil region, and 2 sheets of oil well sections. 8°, pp. 439, 1883. (*Note.—The first 147 pages of this book contain oil well records; see under Petroleum Fields below.*

J. Report on the OIL REGION, by H. E. Wrigley; map and profile of line of levels through Butler, Armstrong, and Clarion, by D. J. Lucas; map and profile of Slippery Rock creek, by J. P. Lesley. 5 maps and sections, a plate and 5 cuts. 8°, pp. 122, 1875.

K. Report on GREENE and WASHINGTON counties, by J. J. Stevenson. With two county maps. (Showing the calculated local depths of the Pittsburgh and Waynesburg coal beds beneath the surface.) and 3 page plates of general sections. 8°, pp. 419, 1876. (*Note.—Since the publication of this book* *two colored geological county Maps have been published, and will be found in pocket of volume K 3 described below.*)

K 2. First report on FAYETTE, WESTMORELAND, and S. E. ALLEGHENY counties, (*i. e.*, west of Chestnut Ridge,) by J. J. Stevenson. With 3 colored geological county maps and 50 cuts in the text. 8°, pp. 437, 1877.

K 3. Second report on FAYETTE and WESTMORELAND counties (the Ligonier Valley,) by J. J. Stevenson. With 4 page plates and 107 cuts in text. 8°, pp. 331, 1878. (*Note.—In a pocket in this volume will be found the colored geological maps of Greene and Washington counties alluded to above.*)

K 4. Pt. I, Report on MONONGAHELA RIVER COAL MINES, from the West Virginia State Line to Pittsburgh, (including some on the Youghiogheny and other streams,) by J. Sutton Wall. With a map of the region in a pocket, 12 heliotype pictures, and 26 page plates. 8°, pp. 231, 1884.

L. Report on the YOUGHIOGHENY coke manufacture, by F. Platt; Notes on the coal and iron ore beds, by C. A. Young; Report on methods of coking, by J. Fulton, (*See G* below;) Report on the use of natural gas in the iron manufacture, by J. B. Pearse and F. Platt; The Boyd's Hill gas well at Pittsburgh, by J. P. Lesley. With a map of the coke region, two folded plates of coke ovens, and page plates and cuts in the text. 8°, pp. 252, 1876.

Q. Report on BEAVER, N. W. ALLEGHENY, and S. BUTLER counties by I. C. White. With 3 colored geological county maps, and 21 page plates of sections. 8°, pp. 337, 1878.

Q 2. Report on LAWRENCE county, and special Report on Correlation of the Pennsylvania and Ohio coal beds, by I. C. White. With a colored geological county map and 134 cuts in the text. 8°, pp. 336, 1879.

Q 3. Report on MERCER county, by I. C. White. With a colored geological county map and 119 cuts in the text. 8°, pp. 233, 1880.

Q 4. Report on CRAWFORD and ERIE counties, by I. C. White. With two colored geological county maps and 107 cuts in the text. Also, a Report on a pre-glacial outlet for Lake Erie, by J. W. Spencer. With two maps of the Lake region. 8°, pp. 406, 1881.

R. Report on McKEAN county, and its geological connections with Cameron, Elk, and Forest counties, by C. A. Ashburner. With 33 page plates of vertical and columnar sections, pictures of Rock city and Olean conglomerate, Wilcox and Kane spouting wells, map of Howard Hill coal field, &c., and an atlas of 8 sheets. 8°, pp. 371, 1880.

(R.) ATLAS for McKean county of 8 sheets:—Colored geological county map; three topographical maps; of Buffalo Coal Company tract, Alton coal basin, and Potato Creek coal basin: map of McKean oil district; one sheet of columnar sections between Bradford and Ridgway; and 2 diagram sheets of the Well account and Production account in the Bradford district.

R 2. Part II, report on township geology of CAMERON, ELK, and FOREST counties, by C. A. Ashburner.

(R 2.) ATLAS for CAMERON, ELK, and FOREST counties, of 11 sheets (*Published November, 1884, in advance of the report*):—3 colored geological county maps; 1 anticlinal and synclinal map; 1 topographical map McKean county; 2 tract maps Forest and Elk counties; 1 map Straight Creek coal basin; 2 sheets oil well sections; and 1 sheet coal sections.

V. Report on N. BUTLER county; and (Part 2) special report on the Beaver and Shenango river coal measures, by H. M. Chance. With a colored geological map of N. Butler; a contour local map around Parker; a map of the anticlinal rolls in the 6th basin; a chart of the Beaver and Shenango rivers; profile section from Homewood to Sharon: Oil well records and surface sections; and 154 cuts in the text. 8°, pp. 248, 1879.

V 2. Report on CLARION county, by H. M. Chance. With a colored geological county map, a map of the anticlinals and oil-belt; a contoured map of the old river channel at Parker; 4 page plates, and 88 cuts in the text. 8°, pp. 232, 1880.

For the coal basins of BRADFORD and TIOGA counties, see report G.

For the coal basins of LYCOMING and SULLIVAN, see report G 2.

For the coal basins of POTTER county, see G 3.

For the coal basins of CLINTON county, see G 4.

For the coal in WAYNE county, see G 5.

For the East Broad Top coal basin in HUNTINGDON county, see F.

For the mountain coals in BLAIR county, see T.

For the Broad Top coal measures in BEDFORD and FULTON counties, see T 2.

For the coal basins in CENTRE county, see T 4.

For coal analyses, see M, M 2, M 3.

For classification of coals, see in M 2.

For coal plants, see P, P 2.

For fossil crustaceans in coal slate, see P 3.

For Origin of Coal; Pittsburgh Region and Monongahela Valley: Wellersburg coal basin, Somerset county; and Tipton Run coal-beds, Blair county, see Annual Report, 1885.

Grand Atlas Div. III, Pt. I, 1885, port-folio containing 35 sheets (26"×32') as follows: 32 sheets relating to portions of the Petroleum and Bituminous Coal Fields, and 3 sheets relating to the Quaternary period.

Annual Report, 1886. Part I.

PETROLEUM AND GAS.

See reports I, I 2, I 3, I 4, and J, under Bituminous Coal Fields.

See L, for the Pittsburgh gas well, and the use of gas in the iron manufacture.

See Q, Q 2, Q 3, Q 4, for references to oil rocks in Beaver, Lawrence, Mercer, Crawford, Erie, and S. Butler counties.

See K for the Dunkard Creek oil wells of Greene county.

See R, R 2, for descriptions of oil rocks in McKean, Elk, and Forest counties.

See V, V 2, for notes on the oil rocks of N. Butler and Clarion counties.

See H 2 for oil boring at Cherry Tree, Cambria county.

See G 5 for oil boring in Wayne county.

See Annual Report, 1885, for report of progress in the oil and gas region, with special facts relating to the geology and physics of natural gas.

See Grand Atlas, Div. III, Pt. I, under Bituminous Coal Fields.

See Annual Report, 1886. Part II.

NORTH-EASTERN AND MIDDLE PENNSYLVANIA.

(Palæozoic formations from the Coal Measures down.)

D. First report on LEHIGH county iron mines, by F. Prime. With a contour line map of the ore region and 8 page plates. 8°, pp. 73, 1875.

D 2. Second report on LEHIGH county iron mines, by F. Prime. With a colored geological contour line map of the iron region, (in 4 sheets,) a colored geological contour line map of the Ironton mines, 4 double page lithograph pictures of Limestone quarries, and one page plate of *Monocraterion*. 8°, pp. 99. 1878.

D 3. Vol. I. Report on LEHIGH and NORTHAMPTON counties. Introduction by J. P. Lesley; Slate belt, by R. H. Sanders; Limestone belt and iron mines, by F. Prime; South mountain rocks, by F. Prime and C. E. Hall. With 3 lithograph pictures of quarries, 4 pictures of triangulation stations, 14 page plates of sections, and an atlas of maps. 8°, pp. 283, 1883. (*Note.—For atlas see below.*)

D 3. Vol. II, Part I. Report on BERKS county, (*South mountain belt*,) by E. V. d'Invilliers. With 10 page plates of sections and Indian relics, and 3 pictures of rock exposures. 8°, pp. 441, 1883. (*Note.—For atlas see below.*)

(D 3.) ATLAS: One colored geological map of *Lehigh* and Northampton counties, (*one sheet;*) one colored geological contour line map of Southern Northampton county, (*six sheets;*) a contour line map of the mountains from the Delaware to the Schuylkill, (*eighteen sheets;*) a colored geological contour line index map to the 22 sheets, (*one sheet;*) and 4 sheets of maps of iron mines.

(D 5.) ATLAS of colored geological county maps of CUMBERLAND, FRANKLIN, and ADAMS, (*three sheets;*) and first installment of contour line map of the South mountains, Sheets A 1, A 2, B 1, B 2, (*four sheets*,) by A. E. Lehman.

F. Report on the JUNIATA RIVER district in MIFFLIN, SNYDER, and HUNTINGDON counties, by J. H. Dewees, and on the Aughwick valley and East Broad Top region in HUNTINGDON county, by C. A. Ashburner. With colored geological maps of East Broad Top R. R. and Orbisonia vicinity, (2 sheets;) Three Springs map and section, (2 sheets;) Sideling Hill Creek map and section, (2 sheets,) and Isometric projection at Three Springs, (1 sheet;) six folded cross sections and 22 page plates of local maps and columnar sections. 8°, pp. 305, 1878.

F 2. Report on PERRY county, (*Part I, geology*,) by E. W. Claypole. With two colored geological maps of the county; 17 geological outline township maps as page plates, and 30 page plate cross and columnar sections. 8°, pp. 437, 1884.

G. Report on BRADFORD and TIOGA counties, by A. Sherwood; report on their coal fields, (including forks of Pine creek in Potter county,) by F. Platt; report on the COKING of bituminous coal, by J. Fulton. (*See L above.*) With two colored geological county maps, 3 page plates, and 35 cuts in the text. 8°, pp. 271, 1878.

G 2. Report on LYCOMING and SULLIVAN counties; field notes by A. Sherwood; coal basins by F. Platt. With two colored geological county maps, (of Lycoming and Sullivan,) a topographical map (in two sheets) of the Little Pine creek coal basin, and 24 page plates of columnar sections. 8°, pp. 268, 1880.

G 3. Report on POTTER county, by A. Sherwood. Report on its COAL FIELDS, by F. Platt. With a colored geological county map, 2 folded plates and 2 page plates of sections. 8°, pp. 121, 1880.

G 4. Report on CLINTON county, by H. M. Chance, including a description of the Renovo coal basin, by C. A. Ashburner, and notes on the Tangascootac coal basin, by F. Platt. With a colored geological county map, 1 sheet of sections, local Renovo map, 6 page plates, and 21 sections in the text. 8°, pp. 183, 1880.

G 5. Report on SUSQUEHANNA and WAYNE counties, by I. C. White. With a colored geological map of the two counties and 58 cuts in the text. 8°, pp. 243, 1881.

G 6. Report on PIKE and MONROE counties, by I. C. White. With two colored geological county maps, (1 sheet Pike and Monroe and 1 sheet Wyoming,) a map of glacial scratches, and 7 small sections. Report on the Delaware and Lehigh Water Gaps, with two contoured maps and five sections of the gaps, by H. M. Chance. 8°, pp. 407, 1882.

G 7. Report on WYOMING, LACKAWANNA, LUZERNE, COLUMBIA, MONTOUR, and NORTHUMBERLAND counties, (*i. e.*, the parts lying *outside* of the anthracite coal fields,) by I. C. White. With a colored geological map of these counties, (in two sheets,) and 31 page plates in the text, 8°, pp. 464, 1883. (*Note.—The colored geological map of* WYOMING *county is published in G 6.*)

T. Report on BLAIR county, by F. Platt. With 35 cuts in the text, and an Atlas of maps and sections, (see below.) 8°, pp. 311, 1881.

(T.) Atlas of colored geological contour line map of Morrison's cove, Canoe valley, Sinking valley, and country west to the Cambria county line, (14 sheets;) Index map of the same, (1 sheet;) colored sections (2 sheets.) 8°, 1881.

T 2. Report on BEDFORD and FULTON counties, by J. J. Stevenson. With two colored geological maps of the two counties. 8°, pp. 382, 1882.

T 3. Report on HUNTINGDON county, by I. C. White. With a colored geological map of the county, and numerous sections. 8°, pp. 471, 1885.

T 4. Report on CENTRE county, by E. V. d'Invilliers; also special report, by A. L. Ewing, and extracts from report to Lyon, Shorb & Co., by J. P. Lesley. With a colored geological map of the county, 13 page plates of local maps and sections, and 15 cuts in the text. 8°, pp. 464, 1884.

For report on line of the Terminal Moraine, see Z.

GRAND ATLAS, Div. IV, Pt. I, 1885. Port-folio containing 43 sheets, as follows: 30 sheets relating to the Durham and Reading Hills and bordering valleys in Northampton, Lehigh, Bucks, and Berks counties, and 13 sheets relating to the South Mountains in Adams, Franklin, Cumberland, and York counties.

GRAND ATLAS, Div. V., Pt. I, 1885. Port-folio containing 35 sheets, as follows: 29 sheets relating to the Topography and Geology of the Palæozoic strata in parts of Cambria, Blair, Bedford, Huntingdon, Mifflin, Centre, and Union counties, 5 sheets contain a map and geological cross section along the east bank of the Susquehanna river, Lancaster county, and 1 sheet contains cross sections of the Philadelphia belt of the Azoic rocks.

For report on Cornwall Iron Ore Mines, Lebanon county, and the Tipton Run coal-beds, Blair county, see Annual Report, 1885.

SOUTH-EASTERN PENNSYLVANIA.

C. Report on YORK and ADAMS counties, by P. Frazer. With one folded map of a belt of York county through York and Hanover, 6 folded cross sections, and two page plate microscopic slices of dolerite. 8°, pp. 198, 1876. (*Note.—The colored geological county map of* YORK *is published in the* ATLAS *to C 3.*)

C 2. Report on YORK and ADAMS counties, (South Mountain rocks, iron ores, &c.,) by P. Frazer. With one general map of the district, 10 folded cross sections, and 5 page plates. 8°, pp. 400, 1877. (*Note.—The colored geological county map of* ADAMS *is published in D 5.*)

C 3. Report on LANCASTER county, by P. Frazer. With nine double page lithographic views of slate quarries and Indian-pictured rocks, one plate of impressions on slate, and one page plate microscopic section of trap, and an atlas. 8°, pp. 350, 1880.

(**C 3.**) ATLAS of 13 sheets: Colored geological map of York county; colored geological map of LANCASTER county; Susquehanna river section. (Sheets 1, 1A, 2, 2A, 3, 4;) Lancaster section; Pequea section; Muddy run section; Chestnut Hill mines; Gap Nickel mine.

C 4. Report on CHESTER county: General description, pp. 214, by J. P Lesley; Field notes in the townships, pp. 215–354, by P. Frazer. With a colored geological county map, a photographic view of contorted schists, and 12 page plates. 8°, pp. 394, 1883.

C 5. Report on DELAWARE county, by C. E. Hall. With a colored geological county map; 30 photographic page plate views of granite quarries, kaolin pits, &c., and 4 page plates of altered mica. 8°, pp. 128, 1885. See Annual Report, 1885, for Kaolin report.

C 6. Report on PHILADELPHIA and the southern parts of MONTGOMERY and BUCKS counties, by C. E. Hall. With a colored geological map of the belt of country between Trenton and Delaware county, (in 3 sheets,) a sheet of colored cross sections, and 24 cuts in the text. 8°, pp. 145, 1882.

E. Part I of (historical introduction to) a report on the AZOIC rocks, by T S. Hunt. 8°, pp. 253, 1878.

For report on the kaoline deposits of CHESTER and DELAWARE counties, see Annual Report, 1885.

See also GRAND ATLAS, Div. V., Pt. I, under North-eastern and Middle Pennsylvania.

July 1, 1887.

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